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Part I: Primary Recipient*: Remediation or LUST (* required)

For Remediation documents:	For LUST documents:
Primary Program*: Voluntary Remediation	UST Facility ID: (if applicable)
Rem ID*: 12390	Spill Case Number: (if known)

Part II: Site Information

Site Name*: Rockville Former Manufactured Gas Plant
Site Address*: 13 Maple/ West Main Street
City/Town*: Rockville, Vernon State: CT Zip Code: 06066

Secondary Programs (complete as many as applicable for this document):

Program: Select Secondary Program	Project ID:
Program: Select Secondary Program	Project ID:
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Provide Project ID for each secondary program if it is known.
Each program has a unique ID (i.e. Rem ID, Spill Case #, UST Facility ID, etc.)

Part III: Document Information (document type required for appropriate program[s] only)

Remediation*: SLERA Risk Assessment Report
LUST*: LUST Document Type
Date of Document*: 3/31/2021 Version: Final

Part IV: Submitter Information

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Name of company/business this document is being submitted on behalf of: *
The Connecticut Light & Power Co. dba Eversource

Tighe&Bond

14-5042-024
March 31, 2021

Ms. Traci Iott, Supervising Environmental Analyst
Water Quality Program
Bureau of Water Protection and Land Reuse
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Re: **Screening Level Ecological Risk Assessment**
Rockville Former Manufactured Gas Plant
Rockville, Vernon, Connecticut
REM ID No. 12390

Dear Ms. Iott:

On behalf of The Connecticut Light and Power Company (CL&P) dba Eversource Energy (Eversource), Exponent, Inc., under contract to Tighe and Bond, Inc. (Tighe & Bond), has prepared the enclosed screening-level ecological risk assessment (SLERA) for the Rockville Former Manufactured Gas Plant (MGP) site located at 13 Maple Street/West Main Street in Rockville, Vernon, Connecticut, referred to as the Site.

This SLERA was developed as a component of the Phase III Environmental Site Assessment (ESA) of the Site, which is being conducted by Tighe & Bond, to assess potential exposure pathways to ecological receptors at the Hockanum River. The Phase III ESA is being completed to assess the nature and extent of impacts associated with the Rockville Former MGP Site under the Connecticut Department of Energy and Environmental Protection's (CTDEEPs) Voluntary Remediation Program (VRP). The SLERA was prepared, as described by United States Environmental Protection Agency (U.S. EPA) guidance (U.S. EPA 1992, 1997), for the Rockville Former MGP Site.

Historically, the Hockanum River was integral to the industrial development of Rockville. The river was dammed and re-channelized for waterpower for multiple textile mills that lined the waterway. Fill materials were likely used during initial develop development of the area based upon site investigations. Numerous textile mills operated upstream of the Site from the 1800s through the post-World War II era. The Rockville Former MGP operated from circa 1863 until circa the mid-1930s after which the Site appears to have been primarily used for manufactured gas storage until the 1950s. A home heating oil distributor with aboveground oil tank, Gottier Fuel is located at the southeast intersection of Maple Street and West Main Street, directly upstream of the Site.

The ecological conceptual site model noted historic fill material, historical discharges at the Site and/or current off-site stormwater discharges as potential primary sources for impacts to the ecology of the river. Upstream sediments and surface water were also identified as a secondary source for impacts to the Site.

The SLERA identified several chemicals of potential ecological concern (CoPECs), including polycyclic aromatic hydrocarbons (PAHs) and metals present at concentrations in sediment and/or surface waters that resulted in quantitative risk estimates referred to as hazard quotients (HQ) greater than 1. A HQ greater than 1 indicates some potential for adverse ecological effects but do not signify unacceptable risk. Upstream sediment and/or surface water samples also contained similar PAHs and some similar metals at concentrations that

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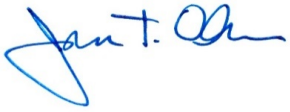
resulted in hazard quotients greater 1. This also suggests that the risk assumptions used in the SLERA for on-site ecological receptors are quite conservative.

Based on the SLERA results, Exponent has determined that the available information indicates a potential for adverse ecological effects from CoPECs in the Hockanum River at the Site to benthic invertebrates, fishes, and semi-aquatic wildlife, which requires further evaluation in a baseline ecological risk assessment (BERA). However, careful consideration should be given with regards to the BERA in light of elevated concentrations of a number of COPECs found in the Hockanum River upstream of the Site.

We request a meeting with you to discuss the findings of the SLERA and potential next steps.

If you have any questions or comments, please me at 860-704-4761 or at JTOlsen@tighebond.com.

Very truly yours,
TIGHE & BOND



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Ecological & Biological Sciences

Screening-Level Ecological Risk Assessment, Rockville Former Manufactured Gas Plant Site 13 Maple Street/West Main Street Rockville, Vernon, Connecticut REM ID: 12390

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Screening-Level Ecological Risk Assessment, Rockville Former Manufactured Gas Plant Site 13 Maple Street/West Main Street Rockville, Vernon, Connecticut REM ID: 12390

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March 30, 2021

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Contents

		Page
List of Figures		**iv**
List of Tables		**v**
Acronyms and Abbreviations		**vii**
1	**Introduction**	**1**
2	**Site Conditions**	**3**
2.1	Site Description and History	3
2.2	Previous Investigations and Available Data	4
2.2.1	Manufactured Gas Plant Site Investigation: Rockville, March 1992	4
2.2.2	Rockville Manufactured Gas Plant Site, Field Summary Report (1994), April 1995	4
2.2.3	Tighe & Bond Sediment and Surface Water Sampling in 2017	5
2.2.4	Tighe & Bond Sediment Sampling in 2018	6
2.2.5	Tighe & Bond Sediment Sampling in 2021	7
2.3	Habitat Characterization	7
2.4	Species of Special Concern and Sensitive Habitats	8
2.5	Evaluation of Ecological Habitats and Exposure Pathways	8
3	**Screening-level Problem Formulation**	**10**
3.1	Site Visit	10
3.2	Exposure Pathways and Conceptual Site Model	11
3.3	Assessment and Measurement Endpoints	11
3.4	Identification of Chemicals of Potential Ecological Concern	13
3.4.1	Sediment	14
3.4.2	Surface Water	15
4	**Screening-Level Exposure Estimate and Risk Calculation**	**17**
4.1	Exposure Estimate and Risk Calculation for Benthic Invertebrates, Amphibians, and Fishes	17
4.2	Exposure Estimate and Risk Calculation for Wildlife	17
4.2.1	Wildlife Representative Receptors	18

4.2.2 Screening-level Food-chain Models for Wildlife 20
4.2.3 Exposure Point Concentrations 21
4.2.4 Toxicity Reference Value for Benthic Invertebrates, Fishes, and Amphibians 23
4.2.5 Toxicity Reference Values for Wildlife 25
4.3 Results of Screening-Level Exposure Estimate and Risk Calculation 26
4.3.1 Screening-level Results for Benthic Invertebrates (Assessment Endpoint 1) 26
4.3.2 Screening-level Results for Amphibians (Assessment Endpoint 2) 26
4.3.3 Screening-level Results for Fishes (Assessment Endpoint 3) 26
4.3.4 Screening-level Results for Wildlife (Assessment Endpoint 4) 27
4.3.5 Summary of Screening-level Results 27

5 Uncertainty Analysis 28

5.1 Uncertainties Associated with SLs and TRVs 28
5.2 Uncertainty Associated with CoPEC Selection 28
5.3 Uncertainty Associated with Bioaccumulation Factors and Trophic Transfer Factors 29
5.4 Uncertainty Associated with the Food-Chain Models 29
5.5 Chemical Concentrations Upstream of the Site in Hockanum River 30
5.5.1 Tighe & Bond Upstream Sediment and Surface Water Sampling 2020 30
5.5.2 Screening-Level Exposure Estimate and Risk Calculation for Upstream Data 31

6 Summary and Conclusions 32

7 References 35

Figures
Tables
Appendix A Analytical Data used in the Screening-Level Ecological Risk Assessment
Appendix B Supporting Tables for the Chemicals of Potential Ecological Concern Selection
Appendix C Amphibian Water Values
Appendix D Wildlife Toxicity Reference Values Development
Appendix E Food-chain Models for Wildlife
Appendix F Supporting Tables for Evaluation of Sediment and Surface Water Data Upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

List of Figures

Figure 1. Site location map, Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 2. Aerial photograph, Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 3. Parcels of land that comprise the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 4. Historical sediment and surface water sample location in the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 5. Current sediment and surface water sample locations in the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 6. Natural Diversity Data Base Areas relative to the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 7. Natural Diversity Data Base freshwater mussel map relative to the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 8. Locations of northern long-eared bat areas in Connecticut relative to the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 9. Ecological conceptual site model for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 10. Selection process for chemicals of potential ecological concern in sediment and surface water, Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figure 11. Current sediment and surface water sample locations in the Hockanum River upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Figures appear following the main text.

List of Tables

Table 1. Summary statistics of chemistry data for sediment samples in the Hockanum River at the Site

Table 2. Summary statistics of chemistry data for surface water samples in the Hockanum River at the Site

Table 3. Ecological screening levels selected for freshwater sediments

Table 4. Summary of chemicals of potential ecological concern for sediment

Table 5. Ecological screening levels selected for freshwater

Table 6. Summary of chemicals of potential ecological concern for surface water

Table 7. Combined list of chemicals of potential ecological concern

Table 8. Exposure profiles for wildlife receptors

Table 9. Exposure point concentrations for sediment and surface water

Table 10. Exposure point concentrations for plants, invertebrates, and fishes

Table 11. Toxicity reference values for benthic invertebrates, amphibians, and fishes

Table 12. Toxicity reference values for avian wildlife

Table 13. Toxicity reference values for mammalian wildlife

Table 14. Benthic invertebrate assessment endpoint results – hazard quotients using sediment toxicity reference values

Table 15. Amphibian and fish assessment endpoints results – hazard quotients for aquatic life using surface water toxicity reference values

Table 16. Wildlife assessment endpoint results – hazard quotients for the mallard, great blue heron, and raccoon

Table 17. Results of benthic invertebrates, aquatic life, and wildlife assessments using Site concentration data

Table 18. Summary statistics of chemistry data for sediment samples in the Hockanum River upstream of the Site

Table 19. Summary statistics of chemistry data for surface water samples in the Hockanum River upstream of the Site

Table 20. Comparison of Site exposure point concentrations and upstream exposure point concentrations

Table 21. Results of benthic invertebrates, aquatic life, and wildlife assessments using upstream concentration data

Tables appear following the main text.

Acronyms and Abbreviations

%	percent
BAF	bioaccumulation factor
BCC	bioaccumulative chemical compound
BERA	baseline ecological risk assessment
CTDEEP	Connecticut Department of Energy and Environmental Protection
CL&P	Connecticut Light and Power Company
CoPEC	chemical of potential ecological concern
dba	doing business as
Eco-SSL	ecological soil screening level
ECOTOX	ECOTOXicology database
EPC	exposure point concentration
ERA	ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
Eversource	Eversource Energy
ETPH	Extractable Total Petroleum Hydrocarbons
SL	screening level
ESV	ecological screening value
ft	feet
FWS	U.S. Fish and Wildlife Service
HQ	hazard quotient
LOAEL	lowest-observed-adverse-effect level
MDC	maximum detected concentration
MGP	manufactured gas plant
MRL	maximum reporting limit
NDDB	Natural Diversity Data Base
NOAEL	no-observed-adverse-effect level
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
RCRA	Resource Conservation Recovery Act
RSV	refined screening value
RSR	Remediation Standard Regulations
SLERA	screening-level ecological risk assessment
SVOC	semi-volatile organic compound
TEC	threshold effect concentration
TEL	threshold effect level
TPH	total petroleum hydrocarbon
TRV	toxicity reference value
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
VRP	Voluntary Remediation Program

1 Introduction

On behalf of The Connecticut Light and Power Company (CL&P) dba Eversource Energy (Eversource), Exponent, Inc., under contract to Tighe and Bond, Inc. (Tighe & Bond), has prepared this screening-level ecological risk assessment (SLERA) for the Rockville Former Manufactured Gas Plant (MGP) site located at 13 Maple Street/West Main Street in Rockville, Vernon, Connecticut, referred to as the Site. The Site location is provided on Figure 1.

This SLERA was developed as a component of the Phase III Environmental Site Assessment (ESA) of the Site, which is being conducted by Tighe & Bond, Inc. (Tighe & Bond) to assess potential exposure pathways to ecological receptors at the Hockanum River. The Phase III ESA is being completed under the Connecticut Department of Energy and Environmental Protection (CTDEEP) Voluntary Remediation Program (VRP). The SLERA was prepared, as described by United States Environmental Protection Agency (U.S. EPA) guidance (U.S. EPA 1992, 1997), for the Rockville Former MGP Site. The SLERA includes a site description and habitat characterization, identification of complete exposure pathways, and a screening-level exposure estimate and risk calculation (U.S. EPA 1997).

The SLERA is based on U.S. EPA guidance per CTDEEP recommendation and considers the following key guidance documents:

- **The U.S. EPA Framework for Ecological Risk Assessment (Framework)** (U.S. EPA 1992) – The Framework describes a consistent approach for conducting an ecological risk assessment (ERA), it also identifies key issues, and defines terms used in ERA. The ERA process was developed to be flexible while providing a logical and scientific structure to accommodate a broad array of stressors. Guidance documents followed to further the ERA concepts presented in the Framework.
- **The U.S. EPA Ecological Risk Assessment Guidance for Superfund (ERAGS)** (U.S. EPA 1997) – ERAGS is specific guidance establishing the fundamental tiered process for conducting an ERA at hazardous waste sites. This SLERA focuses on the first two steps of the ERA process.
- **Guidelines for Ecological Risk Assessment (Guidelines)** (U.S. EPA 1998) – The Guidelines focus on the processes of ERA to improve the quality and consistency of ERAs conducted for hazardous waste sites.

The objective of a SLERA is either to provide a defensible conclusion that negligible ecological risk exists or show that certain chemicals and exposure pathways can be eliminated from further consideration in the ERA process (U.S. EPA 1997). The pathways assessment is a critical step in this process, because it can be used to determine which complete exposure pathways do not exist, and could not exist in the future, and therefore, to conclude that present or future ecological impacts are negligible for these incomplete pathways. The ERAGs Guidance (U.S. EPA 1997) states that a SLERA may reach one of the following conclusions:

- There is adequate information to conclude that ecological risks are negligible, and therefore, no need exists for remediation based on ecological risk.
- The information is inadequate to make a decision at this point, and the ERA process will continue.
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

If a SLERA supports the first conclusion (i.e., negligible risk), the ERA process ends with an appropriately performed and documented SLERA.

According to the ERAGs Guidance (U.S. EPA 1997), the SLERA contains two steps:

- Step 1. Screening-level problem formulation. The intent of the first step is to develop the ecological conceptual site model (CSM) that describes how biota may be exposed to hazardous chemicals present in Site media. This step involves assessing the habitat quality, environmental media of concern, and exposure pathways that could result in biota exposure to hazardous chemicals.
- Step 2. Screening-level exposure estimate and risk calculation. The purpose of the second step is to evaluate whether maximum exposure estimates of chemicals of potential ecological concern (CoPECs) warrant further evaluation in a site-specific ERA (also called a baseline ecological risk assessment [BERA]). The outcome of this second step is highly conservative because it is based on conservative assumptions of exposure. Because of this conservativeness, this step is used to eliminate any CoPECs or pathways that do not present a potential for adverse effects to biota present at the Site.

2 Site Conditions

This section provides a brief summary of the site description, site history, previous investigations, and available data. This section also describes the habitats present at the Site and species of concern. Finally, this section presents an evaluation of ecological habitats and exposure pathways.

2.1 Site Description and History

The Site is located at 13 Maple Street/West Main Street, Rockville, Vernon, Connecticut. The Site is the former MGP property, which is currently used by Eversource as an electrical substation (Rockville 14W) to supply electricity to the surrounding community (Figure 2). The Site is on 3.43 acres of land, which consists of a 2.88-acre parcel located at 13 Maple Street and a second 0.55-acre parcel located at West Main Street. The 2.88-acre parcel contains the active substation, whereas the 0.55-acre parcel on the south side of the substation parcel contains a portion of the Hockanum River (Figure 3). The Hockanum River flows through the southern portion of the Site and is classified by CTDEEP as Class B waters, meaning that it is designated for use as navigation, recreation, industrial and agricultural water supply, and potential habitat for fish and other aquatic life and wildlife. The river receives stormwater discharges from outfalls along Maple Street at the Site as well as multiple upstream stormwater outfalls. Historical outfall pipes were noted along the river at the Site as discussed below in Sections 2.2.3 through 2.2.5.

The Site is in a developed part of Vernon, Connecticut, and mostly surrounded by properties that are zoned as Historic District Neighborhood. To the west of the Site are residential lots, to the northeast of the Site is the Town of Vernon Maple Street School, to the north of the Site are paved areas for St. Joseph Church, and to the south of the Site is West Main Street and developed lots (Figure 2).

Formerly, a MGP was located at the Site and operated from 1863 until the 1950s when natural gas was brought to the region (Tighe & Bond 2017). Gas production occurred until circa mid-1930s after which the Site appears to have been primarily used for gas storage. A portion of the gas produced was also used to generate electricity at the plant. The MGP manufactured gas from coal using both coal gas and water gas productions methods. The primary by-products of the gasification process were tar, coke, and ammonia liquors that were recycled or sold where possible. Gas purifier wastes were also produced as part of gas manufacturing. Chemicals associated with these by-products include polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), sulfides, cyanides, and ammonia. Inorganic chemicals such as metals can be found in higher concentrations in purifier wastes at MGP sites; however, purifier waste deposits have not been encountered during the Phase III ESA investigations.

Historically, the Hockanum River was integral to the industrial development of Rockville. The river was dammed and re-channelized for waterpower for multiple textile mills. Fill materials were likely used during initial development of the area based upon the Phase III ESA investigations completed between the Hockanum River and West Main Street at the Site.

Eleven historical mill complexes operated upstream of the Site, including the nearby Hockanum Mill and Springville Manufacturing Company mill complexes. Based upon textile manufacturing processes at the time waste products likely could have included dyes (including coal-tar derived dyes), chromium salts, copper sulfate, zinc chloride, mineral oils, sulfuric acid and soda ash. Prior to the development of the sewer system in the late 1890s, process wastes from textile manufacturing could have been discharged to the ground or possibly directly to the river; however, the specific waste disposal practices are unknown. Following World War II, the textile industry in the region began to decline which continued through the following decades after which, many of the mills were left abandoned or underutilized.

2.2 Previous Investigations and Available Data

The Phase I Environmental Site Assessment Report for the Site (Tighe & Bond 2017) describes in detail previous investigations that took place at the Site. The relevant investigations and available data for this SLERA are described in this section.

2.2.1 Manufactured Gas Plant Site Investigation: Rockville, March 1992

In 1990, the Northeast Utilities Service Company conducted a site investigation to assess impacts to the Site and its surroundings from the former Rockville MGP (Northeast Utilities Service Company 1992). The investigation included soil and groundwater sampling as well as the collection of four river sediment and five surface water samples from the Hockanum River. One sediment and surface water station was located upstream of the former MGP (Station A), two stations were located adjacent to former MGP (Stations B and C), and one station was located downstream of the former MGP (Station D) (Figure 4). Sediment samples were collected by grab sample within 6 ft of the shore and surface water samples were collected by grab sample. The sediment and surface water samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs) including PAHs, metals and cyanide. Chemical concentration data for sediment and surface water samples from the 1990 sampling event are available only for analytes that were detected at least once in the respective medium.

2.2.2 Rockville Manufactured Gas Plant Site, Field Summary Report (1994), April 1995

In summer and fall of 1994, the Northeast Utilities Service Company conducted various field sampling at the former Rockville MGP Site (Northeast Utilities Service Company 1995). The field sampling was conducted to support the development of a human health risk assessment for

the Site, and samples included surficial soil as well as sediment and fish from the Hockanum River. Three sediment samples were collected: two samples were collected from stations (R-SED-A and R-SED-B) adjacent to the former MGP and one station (R-SED-C) at the edge of the property downstream of the former MGP (Figure 4). Sediment samples were collected from the 5 to 12 inches below the riverbed because the river bottom at depths between 0 and 5 inches was very hard. The sediment samples were analyzed for VOCs, PAHs, total petroleum hydrocarbons (TPH), Aroclor polychlorinated biphenyls (PCBs), Resource Conservation Recovery Act (RCRA)-13 metals, pH, and cyanide (total and amenable). Fish (white sucker) samples were collected by seine net. The fish were generally 10 to 16 inches long and weighed approximately one to two pounds. Fish were composited into seven fish samples and were analyzed for PAHs, Aroclor PCBs, RCRA-8 metals, and total cyanide.

2.2.3 Tighe & Bond Sediment and Surface Water Sampling in 2017

Tighe & Bond collected sediment and surface water samples from the Hockanum River in 2017 since sediment samples collected previously were approximately 26 to 30 years old and no longer represent current conditions near the Site.

On November 13, 2017, Tighe & Bond collected sediment samples from six locations (SED-01, SED-02, SED-03, SED-04, SED-05, and SED-06) in the Hockanum River and one field duplicate sample from location SED-02 (Figure 5). Sediment was collected using decontaminated stainless-steel hand sampling tools from within the top six inches of the sediment surface (surficial samples) in areas typically downstream of rocks in depositional zones. This sampling strategy increased the opportunity to detect potential chemicals in the sediment. The following are descriptions of the sediment samples and locations:

- SED-01: Brown, medium to coarse sand, some gravel, and little silt. The sample was collected at the upstream Site boundary in an area of finer sediment at the bridge.
- SED-02: Brown, fine to medium sand, trace silt, and abraded asphalt in sand. Bricks and concrete were observed nearby. The sample was collected at the confluence of stream and downstream from the outfalls from Maple Street, discussed below in Section 2.2.4.
- SED-03: Brown, medium to coarse sand, little gravel, trace silt, and trace pieces of fill (glass and brick were present). The sample was collected near the previous sediment sample SED-B.
- SED-04: Brown/ Dark Brown, medium to coarse sand, little gravel, and little pieces of fill (glass and brick were present). The sample was collected at the downstream Site boundary near the previous sediment sample SED-C.
- SED-05: Brown, medium to coarse sand, some gravel, trace silt, and possible paint chips. Bricks and concrete were observed nearby. The sample was

collected downstream of SED-02 and upstream of samples SED-03, SED-04, and SED-06.

- SED-06: Brown, medium to coarse sand, some gravel, and trace silt. The sample was collected adjacent to cast iron steel outfall pipes in the northern back of the river and near the previous sediment sample SED-A.

The sediment samples were analyzed for CT extractable total petroleum hydrocarbons (ETPH), 15 metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), cyanide (total), PCB Aroclors, SVOCs, VOCs and total organic carbon.

On November 13, 2017, Tighe & Bond collected surface water samples from four locations (SW-01, SW-02, SW-03, and SW-04) in the Hockanum River and one field duplicate sample from station SW-01 (Figure 5). The SW-01, SW-02, SW-03, and SW-04 surface water stations were collocated with the sediment SED-01, SED-02, SED-03 and SED-04 stations, respectively. The surface water samples were analyzed for CT ETPH, 15 metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), cyanide (total), SVOCs, and VOCs.

2.2.4 Tighe & Bond Sediment Sampling in 2018

Tighe & Bond collected additional sediment samples from the Hockanum River in 2018 to investigate: 1) a sediment location where the 2017 sediment sample (SED-06) contained an elevated concentration of copper (2,190 mg/kg) and, 2) possible sources of off-site contamination to Hockanum River near the Site.

On August 28, 2018, Tighe & Bond collected sediment samples from six locations (SED-06A, SED-06B, SED-06C, SED-07, SED-08, and SED-09) near the Site and one field duplicate sample from station SED-07 was sampled (Figure 5). The following are descriptions of the new sediment samples and locations:

- SED-7: Medium to coarse sand. The sample was collected at the base of the plastic outfall pipe from Maple Street that conveys stormwater drainage from the Maple Street right-of-way and upgradient properties.
- SED-8: Medium to coarse sand. The sample was collected from within the stone masonry constructed outfall at Maple Street. The outfall was associated with the former Hockanum Mill, located approximately 270 ft to the east, and reportedly discharged to the Hockanum River during the operation of the mill.
- SED-9: Fine silty sand. The sample was collected from concrete outfall pipe located near the intersection of the Maple Street and West Main Street and likely receives stormwater drainage from near the intersection of Maple and West Main Street.

Sediment was collected using decontaminated stainless-steel hand sampling tools from within the top six inches of the sediment surface in areas typically downstream of rocks in depositional zones. The sediment samples SED-06A, SED-06B, and SED-06C were only analyzed for copper to determine if the copper concentrations in the 2017 SED-06 sample could be replicated and delineated. The sediment samples SED-07, SED-08 and SED-09 and the field duplicate sample were analyzed for CT ETPH, CTDEEP RSR 15 metals list (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), cyanide (total), PCB Aroclors, SVOCs, and VOCs.

2.2.5 Tighe & Bond Sediment Sampling in 2021

Tighe & Bond collected additional sediment samples from the Hockanum River in 2021 to investigate the locations of former outfall pipes associated with substation piping based upon historical plans along the Hockanum River to determine if they could have contributed to chemical contamination of the river in those areas. Only sediment samples were collected since the pipe outfalls could not be located.

On February 28, 2021, Tighe & Bond collected sediment samples from two locations (SED-201, and SED-202) just downstream of the two pipes along the Hockanum River at the Site (Figure 5). The following are descriptions of these sediment samples:

- SED-201: Medium to coarse sand with little gravel and brick fragments.
- SED-202: Fine to medium sand and organic materials with little silt.

Sediment was collected using decontaminated stainless-steel hand sampling tools from within the top six inches of the sediment surface. The sediment samples SED-201 and SED-202 were analyzed for CT ETPH, 15 metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), cyanide (total), PCB Aroclors, 17 PAHs, grain size, and total organic carbon.

2.3 Habitat Characterization

The Site is approximately 3.4 acres and currently contains an active electrical substation that is surrounded by a chain-link fence. Along the southern portion of the Site is a portion of the Hockanum River, which flows in a northwestern direction across that portion of the Site. Much of the Site is developed land used for the electrical substation. The remaining area includes the Hockanum River and narrow wooded areas along the Hockanum River to the western and southern portions of the Site. The Site is surrounded by streets and developed land. To the north of the Site is the former St. Joseph School, St. Joseph Church, the church parking lot, and residences. To the east of the Site is Maple Street and residences. To the south of the Site is West Main Street and other developed lots including a home heating oil supplier Gottier Fuel, which has a large aboveground fuel oil storage tank adjacent to the Hockanum River. To the west of the Site are residences. Thus, the Site currently provides fragmented habitat for aquatic

life and semi-aquatic wildlife associated with the section of the Hockanum River that flows through the Site.

The Hockanum River begins at the outlet of Shenipsit Lake in Rockville and flows through Vernon, Ellington, Manchester, and East Hartford for about 23 miles before terminating at the Connecticut River. The portion of the Hockanum River present at the Site was narrow (approximately 21 to 25 ft wide) and shallow (approximately 0.5 ft in depth in areas with riffles and runs and approximately 3 ft in depth in pooled areas) when Exponent, Inc. (Exponent) conducted a site visit on September 28, 2020. The river is what is called a losing stream, meaning that groundwater does not flow into it, but surface water from the stream moves into the surrounding groundwater (Tighe & Bond 2017). Historically, the river was used heavily for industry, but the stretches of the riverbank have been redeveloped as parks and hiking trails. The Hockanum River can support aquatic life, such as benthic invertebrates and fish, amphibians, and a variety of water-dependent birds and mammals.

2.4 Species of Special Concern and Sensitive Habitats

According to the CTDEEP Natural Diversity Data Base (NDDB), which was updated in June 2020, the Site is not located within a Natural Diversity Area (Figure 6). The NDDB represents the approximate location of endangered, threatened, and special concern species and significant natural communities in Connecticut. This is consistent with previous investigations and an EPA report (U.S. EPA 1994) that indicated that there were no Federally Endangered Species or Connecticut Species of Concern at the Site. The closest record was more than a mile downstream.

In addition, the NDDB freshwater mussel map shows that the Site is not near any state listed freshwater mussel species (Figure 7). Another species of concern in Connecticut is northern long-eared bat and the Site is not located in area with known places of hibernation for this bat species (Figure 8).

2.5 Evaluation of Ecological Habitats and Exposure Pathways

The following conditions must be met for an area to be considered habitat in the context of an ERA at a site and for that area to be carried forward for further evaluation, within the SLERA:

- Upland (terrestrial) habitat
  - A hazardous constituent release to soil occurred (as documented or inferred from information from previous investigations)
  - The upland habitat is undeveloped and is of sufficient size to support potential ecological receptors
  - The upland habitat is sufficiently accessible to potential ecological receptors

  - The upland habitat will continue to support potential ecological receptors into the foreseeable future.

- Aquatic habitat
  - A hazardous constituent release to the water body occurred (as documented or inferred from information from previous investigations)
  - The water body is of sufficient size and hydroperiod to support potential ecological receptors
  - The water body is sufficiently accessible to potential ecological receptors
  - The water body will continue to support potential ecological receptors into the foreseeable future.

The upland areas present at the Site are currently developed and mostly covered by the electrical substation footprint where the former MGP was located. Small, fragmented wooded areas are found near the Hockanum River on the southern and western portion of the Site, but they provide little to no significant habitat to terrestrial receptors as these areas are discontinuous corridors surrounded by developed lots and streets. Therefore, the upland areas on the Site will not be evaluated in the SLERA.

For aquatic habitats on Site, the stretch of the Hockanum River on the Site provides habitat for aquatic life and some wildlife that may use aquatic areas to feed. Hazardous constituents from the MGP activities may have been historically transported to the river. Previous investigations found fill materials in the southern boundary of the Inner Substation fence along the bank of the Hockanum River. In addition, two cast iron pipes were found near the current southeast corner of the inner substation fence; however, the use of the pipes is unknown (Tighe & Bond 2017). Of note, the river also received stormwater runoff from paved roads and historically received wastes from mills upstream of the Site. The Hockanum River is of sufficient size and flows year-round to support potential ecological receptors. In addition, the river is accessible to potential ecological receptors, such as amphibians, fish, benthic invertebrates, birds and mammals. However, this stretch of the Hockanum River is within a developed area and those species that are more tolerant to human activities are more likely to use this stretch of the river. The Hockanum River will continue to support aquatic life and limited semi-aquatic wildlife into the foreseeable future.

3 Screening-level Problem Formulation

The problem formulation step in the SLERA summarizes and identifies complete exposure pathways, assessment and measurement endpoints, and the process for selecting CoPECs.

3.1 Site Visit

On September 28, 2020, Ms. Margaret McArdle, an ecotoxicologist and ecological risk assessor with Exponent, conducted a site visit to assess site conditions and habitat characteristics of the Hockanum River to evaluate potential exposure pathways for the SLERA and identify ecological receptors that could use the Site.

During the site visit, Ms. McArdle observed the following species:

- Fishes, including small minnows (*Cyprindae* sp.)
- Invertebrates, including water striders (order Heteroptera)
- Amphibians, including green frog (*Rana* sp.).

These observations provide field evidence that the Site is capable of supporting small fish species, juvenile fish, aquatic invertebrates, and amphibians. In addition, the habitat appears to be capable of supporting the following species as some portion of their habitat, although Ms. McArdle did not directly observe them during her site visit:

- Larger fish species, such as centrachids (e.g., bluegill sunfish) and bottom dwelling fish (e.g., suckers and bullheads)
- Semi-aquatic birds and mammals (e.g., mallard,[1] great blue heron, and raccoon).

Ms. McArdle looked for but did not find any sheens or other visible hazardous waste associated with the former MGP in the river or along the bank. However, the riverbank and bed did contain plastic bags, broken glass, plastics, fabric, bricks, asphalt pieces and other debris from historical filling of the riverbanks.

[1] A type of dabbling duck.

3.2 Exposure Pathways and Conceptual Site Model

The primary sources of chemicals to the Hockanum River at the Site could be historic fill materials from the former MGP as well as outfall pipes to the river that originate in the northern bank of the river near the former MGP area, former outfall pipes that were located in the northern river back at the current substation, stormwater outfall pipes along Maple Street, and the historic outfall associated with the Hockanum Mill. This stretch of the Hockanum River is characterized as a "losing stream", meaning that the stream is not replenished by nearby groundwater, rather the surface water replenishes the nearby groundwater. Based upon Tighe & Bond Phase III ESA investigations, groundwater to the north of the Hockanum River in the area of the former MGP and substation flows northward away from the river. Therefore, chemicals in groundwater from the Site are unlikely to migrate to the Hockanum River through this pathway. Chemicals in the fill material could reach the river sediment and surface water. In addition, pipes found along the riverbank from the former MGP area could have historically discharged MGP-related chemicals to the river surface water and deposited on sediments. The Site is located with an urban area and conditions at the Site are also likely to be influenced by urban runoff and upstream point sources.

Benthic invertebrates, amphibians and fish within the Hockanum River at the Site could be exposed to chemicals associated with the former MGP and other sources, e.g., urban runoff, via direct contact and ingestion of contaminated surface water and sediment as well as ingestion of contaminated prey. In addition, omnivorous and piscivorous wildlife may drink and feed from the Hockanum River and be exposed to chemicals associated with the former MGP through ingestion of surface water, sediment and biota. Direct contact with contaminated sediment and surface water is considered an incomplete pathway for wildlife since their time in the river is often limited. Food-chain pathways for herbivores would likely be limited due to the little aquatic vegetation observed in this stretch of the Hockanum River; however, herbivorous birds could use this stretch of the river to dabble for aquatic vegetation occasionally. The ecological conceptual site model for the Hockanum River portion of the Site is shown in Figure 9.

3.3 Assessment and Measurement Endpoints

U.S. EPA guidance (U.S. EPA 1997) states that "assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals from the site." According to this guidance, the selection of assessment endpoints depends on:

- The chemicals present and their concentrations
- Mechanisms of toxicity of the chemicals to different groups of organisms
- Ecologically relevant receptor groups that are potentially sensitive or highly exposed to the chemical and attributes of their natural history
- Potentially complete exposure pathways.

Metals, PAHs, other SVOCs, and VOCs were detected in Site media and thus need to be evaluated in the SLERA. Aquatic life, amphibians, and semi-aquatic wildlife may be exposed to these CoPECs in the Hockanum River through the exposure pathways shown in the conceptual site model (Figure 9). Therefore, the assessment endpoints selected for this SLERA are as follows:

1. Survival, growth, and reproduction of benthic invertebrates that live in the Hockanum River sediments near the Site
2. Survival, growth, and reproduction of amphibians that live in the Hockanum River surface water near the Site
3. Survival, growth, and reproduction of fishes that live in the Hockanum River sediment and surface water near the Site
4. Survival, growth, and reproduction of semi-aquatic wildlife, as represented by the mallard, great blue heron, and raccoon, that could use the Hockanum River near the Site.

The assessment endpoints were selected in accordance with U.S. EPA guidance (U.S. EPA 1997). The assessment endpoint represents ecologically relevant receptor groups that are the most highly exposed to the hazardous chemicals and also considers the potentially complete exposure pathways at the Site.

The measurement endpoint used to evaluate the above assessment endpoints are:

1. Survival, growth, and reproduction of benthic invertebrates that live in the Hockanum River sediments near the Site
    - Measurement endpoint 1 is the comparison of the exposure concentration (maximum concentration of CoPECs in the Hockanum River sediment near the Site) to sediment screening levels.
2. Survival, growth, and reproduction of amphibians that live in the Hockanum River surface water near the Site
    - Measurement endpoint 2 is the comparison of the exposure concentration (maximum concentration of CoPECs in the Hockanum River surface water near the Site) to amphibian values.
3. Survival, growth, and reproduction of fishes that live in the Hockanum River surface water near the Site
    - Measurement endpoint 3 is the comparison of the exposure concentration (maximum concentration of CoPECs in the Hockanum River surface water near the Site) to surface water screening levels.
4. Survival, growth, and reproduction of semi-aquatic wildlife, as represented by the mallard, great blue heron, and raccoon, that could use the Hockanum River near the Site.

- Measurement endpoint 4 is the comparison of the total dietary exposure (maximum concentration of CoPECs in the Hockanum River sediment, surface water, aquatic invertebrates, and fish near the Site) to toxicity reference values (TRVs) for the mallard, great blue heron, and raccoon, estimated by using simplified food-chain models.

3.4 Identification of Chemicals of Potential Ecological Concern

The selection process for selecting CoPECs is shown in Figure 10. Each medium (sediment and surface water) are analyzed separately to create two separate lists of CoPECs. The first step of the selection process is to determine if the chemical was detected or not. If the chemical is not detected, then it is determined if an appropriate ecological screening level (SL) is available and whether the maximum reporting limit (MRL) exceeds the SL. If the MRL for non-detected chemical exceeds the SL and there is historical presence (based on historical data from 1990 and 1994 sampling events) or use of chemical at the Site, then the chemical is evaluated in the uncertainty analysis. If the MRL for the non-detected chemical does not exceed the SL or there is no historical presence or use at the Site, then the chemical is eliminated as a CoPEC. If the chemical is detected, but the maximum detected concentration (MDC) does not exceed the SL or no SL is available, and the chemical is not bioaccumulative, then it is eliminated as a CoPEC. If the chemical is detected and the MDC does not exceed the SL or no SL is available, but the chemical is bioaccumulative, then the chemical is retained as a CoPEC. The process for determining if a chemical was bioaccumulative was based on a U.S. EPA document on bioaccumulation (U.S. EPA 2000). If the MDC for the detected chemical exceeds the SL, then it is retained as a CoPEC.

While SLs are useful for the purpose of selecting CoPECs and screening chemistry data, SLs are highly conservative, such that they do not take into account any site-specific characteristics that reduce bioavailability of chemicals in natural sediments and water. In addition, SLs are often derived using uncertainty factors that make the SLs 10- to 100-fold lower than the actual toxicity values on which they are based. Unlike PCBs and certain metals (e.g., cadmium, lead, and mercury), VOCs and most SVOCs are readily metabolized by ecological receptors and therefore generally not bioaccumulative. Uptake of these compounds by living organisms, and accumulation in their tissues, is not an important fate process for these chemicals; therefore, this is not a complete exposure pathway for wildlife. Thus, the bioaccumulative potential of chemicals is considered when selecting CoPECs, in addition to whether the SLs are exceeded.

Sediment and surface water samples were historically collected and chemically analyzed in 1990 and 1994 as part of early site investigations (see Sections 2.2.1 and 2.2.2), yet these historical chemistry data do not represent current conditions due to their age. However, the historical chemistry data were considered in the selection of CoPECs as described above and shown in Figure 10. More current chemistry data are available for the Hockanum River sediment and surface water and best represent current conditions. As described in Sections 2.2.3, 2.2.4, and 2.2.5, sediment and surface water samples were collected from the Hockanum

River in 2017, 2018, and 2021[2] and analyzed for CT ETPH, 15 metals, total cyanide, VOCs, SVOCs, PCB Aroclors (sediments only) and total organic carbon (sediment only) (Tables A-1 and A-2 in Appendix A; data are summarized in Tables 1 and 2). Figure 5 indicates sampling locations for current (2017, 2018, and 2021) sediment and surface water samples.

CoPEC selection for chemicals in sediment and surface water are discussed in more detail, below.

3.4.1 Sediment

Chemistry data for the 2017, 2018, and 2021 sediment samples were screened against available ecological SLs for freshwater sediments and evaluated in additional ways described above in Section 3.4 to identify CoPECs. Surficial sediment samples were collected, when possible, from the top six inches of the sediment column in the Hockanum River at the Site. Samples were analyzed for CT ETPH, metals, cyanide, VOCs, SVOCs, PCB Aroclors (Table A-1 of Appendix A contain the data used in the SLERA; data are summarized in Table 1).

Sediment samples were collected from several locations in the Hockanum River at the Site (Figure 5). Two stations (SED-02 and SED-7) had field duplicates and these results were combined as follows:

- If the results for both the primary and the field duplicate sample were detected values, then the average of the two detected values was used to represent that sample.
- If the results for both the primary and the field duplicate sample were non-detected values, then the lower reported limit was used to represent that sample.
- If the results for the primary or the field duplicate sample was a detected value and the other was a non-detected value, then the detected value was used to represent that sample.

Concentrations of chemicals in sediment were compared to available ecological SLs for freshwater sediment. The NOAA SQuiRT (Buchman 2008) was the predominant source of freshwater sediment SLs (Table 3). Buchman (2008) includes multiple SLs, listed in order of preference: Threshold Effect Concentration (TEC), Threshold Effect Level (TEL), and ARCS Threshold Level (*Hyalella azteca*) (TEL-H). If these sediment SLs were not available for a given chemical, SLs were derived from the following sources, in order of preference: Ecotox Thresholds (U.S. EPA 1996), U.S. EPA Region III BTAG Freshwater Sediment Screening Benchmarks (U.S. EPA 2006), and U.S. EPA Region 5 RCRA Ecological Screening Levels

[2] Surface water samples were collected in the 2017 sampling event but not the 2018 and 2021 sampling events. Sediment samples were collected in the 2017, 2018, and 2021 sampling events.

(U.S. EPA 2003). Finally, if no toxicity-based SLs were available, background levels provided by Buchman (2008) were used as a conservative surrogate for the ecological SL for sediment.

The complete CoPEC evaluation conducted for sediments for all measured analytes is provided in Table B-1 in Appendix B. The summary of chemicals selected as CoPECs for sediment is shown in Table 4. The following chemicals in sediment samples at the Site were retained as CoPECs:

- Ten metals– arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc
- All of the measured PAHs.

While CT ETPH was retained as a CoPEC, it was evaluated through individual compounds in the PAH list since PAHs were detected above their respective sediment SLs.

Several analytes in the sediment samples, including antimony, selenium, silver, cyanide, 35 SVOCs, and 11 VOCs (see Table 4), were not detected but the MRLs were above the respective sediment SLs. These chemicals are discussed further in the uncertainty section (Section 5.2).

3.4.2 Surface Water

Chemistry data for 2017 surface water samples were screened against available ecological SLs for freshwater and evaluated in additional ways described above in Section 3.4 to identify CoPECs. Surface water samples were collected form the Hockanum River at the Site (Figure 5). Surface water samples were analyzed for CT ETPH, metals, cyanide, VOCs, and SVOCs (Tables A-2 of Appendix A contain the data used in the SLERA; data are summarized in Table 2).

Surface water samples were collected from four locations in the Hockanum River at the Site (Figure 5). One station (SW-01) had a field duplicate and these results were combined as follows:

- If the results for both the primary and the field duplicate sample were detected values, then the average of the two detected values was used to represent that sample.
- If the results for both the primary and the field duplicate sample were non-detected values, then the lower reported limit was used to represent that sample.
- If one of the results for the primary or the field duplicate sample was a detected value and the other was a non-detected value, then the detected value was used to represent that sample.

Concentrations of chemicals in surface water were compared to available ecological SLs for freshwater. The Connecticut Water Quality Standards (CT DEEP 2011) was the predominant source of freshwater SLs (Table 5). For chemicals not regulated by the Connecticut Water

Quality Standards, SLs for surface water were derived from the following sources, in order of preference: the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRT; Buchman 2008), Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao 1996), Ecotox Thresholds (U.S. EPA 1996), U.S. EPA Region III BTAG Freshwater Screening Benchmarks (U.S. EPA 2006), and U.S. EPA Region 5 RCRA Ecological Screening Levels (U.S. EPA 2003).

The complete CoPEC evaluation conducted for surface water for all measured analytes is provided in Table B-2 in Appendix B. The summary of chemicals selected as CoPECs for surface water is shown in Table 6. The following chemicals in surface water samples at the Site were retained as CoPECs:

- Two metals– barium and zinc.

Several analytes in the surface water samples, including six metals, cyanide, three PAHs, nine SVOCs and three VOCs (see Table 6), were not detected but the MRLs were above the respective surface water SLs. These chemicals are discussed further in the uncertainty section (Section 5.2).

4 Screening-Level Exposure Estimate and Risk Calculation

For sediment, ten metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc) and all of the PAHs were retained as sediment CoPECs (Table 4). In surface water, barium and zinc were retained as surface water CoPECs (Table 6). A combined list of sediment and surface water CoPECs are presented in Table 7. Therefore, exposure to these chemicals was assessed in the screening-level exposure estimate and risk calculation. The screening process concludes with a scientific management decision point, where it is determined that (1) ecological threats are negligible; (2) the ERA should continue to determine whether a risk exists; or (3) there is a potential for adverse ecological effects, and a more detailed ERA or BERA incorporating more site-specific information, is needed (U.S. EPA 1997).

4.1 Exposure Estimate and Risk Calculation for Benthic Invertebrates, Amphibians, and Fishes

In the screening-level exposure estimate for aquatic life, amphibians, and benthic invertebrates of the Hockanum River, which includes benthic invertebrates, fish and amphibians, the concentrations of CoPECs are compared to ecological screening values (ESVs) for sediment and surface water to develop quantitative risk estimates called hazard quotients (HQs). The HQ is the ratio of the measured or predicted exposure concentration to the ESV:

$$HQ = \frac{\text{Site Conc.}_{CoPEC}}{SL_{CoPEC}}$$

where:

HQ	=	Hazard quotient (unitless)
Site Conc.$_{CoPEC}$	=	Maximum detected concentration of the CoPEC for that medium (mg CoPEC/kg sediment or mg CoPEC/L water)
SL_{CoPEC}	=	Ecological screening value of the CoPEC for that medium (e.g., mg CoPEC/kg sediment or mg CoPEC/L water).

4.2 Exposure Estimate and Risk Calculation for Wildlife

In the screening-level exposure estimate for semi-aquatic wildlife that use the Hockanum River, CoPECs to which ecological receptors are exposed were estimated using a simple food-chain model. In the risk calculation, risk was estimated by comparing the exposure estimates from the

food-chain model to no-effect toxicity reference values (TRVs) to develop quantitative risk estimates called hazard quotients (HQs). The HQ is the ratio of the measured or predicted exposure concentration (dose) to the TRV:

$$HQ = \frac{Dose_{CoPEC}}{TRV_{CoPEC}}$$

where:

HQ	=	Hazard quotient (unitless)
$Dose_{CoPEC}$	=	Total dose of the CoPEC (mg CoPEC/kg body weight/day)
TRV_{CoPEC}	=	Toxicity reference value of the CoPEC (mg CoPEC/kg body weight/day).

HQs below 1 indicate that the chemical is unlikely to cause adverse ecological effects. HQs above 1 indicate some potential for adverse ecological effects but do not signify unacceptable risk. Other pieces of information, such as sources of uncertainty and site-specific exposure information, are weighted in the risk evaluation and the interpretation of the ecological significance of HQs.

4.2.1 Wildlife Representative Receptors

To quantitatively assess risk to an ecological community or feeding guild, it is necessary to select a representative receptor or receptors. The diversity of potentially exposed species and the lack of fundamental knowledge of the interactions between chemicals and many exposed species preclude assessment of risk to all species. According to U.S. EPA guidance, selection of representative receptors may be based on a number of factors, including the following (U.S. EPA 1997):

- Species known to be present at the site
- Species likely to be highly exposed
- Species typical of the community or guild they represent in their behavior, physiology, or sensitivity to CoPECs
- Species for which adequate data exist to allow assessment of exposure and risk.

Risk assessments for representative receptors are therefore interpreted to apply not only to the species assessed but to other species in the community or guild represented. The mallard, great blue heron and raccoon were selected as the representative receptors to evaluate ecological risk at the Site, because they are likely to be present at the Site, highly exposed to chemicals in environmental media, typical of the community or guild they represent in their behavior, physiology, or sensitivity to CoPECs, and because adequate data exists to estimate their exposure and potential risk to CoPECs at the Site.

The mallard (*A. platyrhynchos*) is a surface-feeding duck found in freshwater and saltwater wetland habitats throughout the United States. They feed primarily on aquatic plants; however, females consume benthic invertebrates in the spring before egg production (U.S. EPA 1993). Clutch size range from 1 to 18 eggs, with an average of 9 eggs (U.S. EPA 1993). Breeding occurs in spring but can continue through summer to replace lost nests. Females stay with the young until they fledge. Home ranges of adult females range from 40–1,440 hectares (U.S. EPA 1993).

The great blue heron (*A. herodias*) lives in both saltwater and freshwater environments. It consumes primarily fish, although it also eats small amphibians, larger invertebrates (crabs, crayfish, etc.), insects, and occasionally small mammals (Terres 1980). Great blue herons wade in shallow water and strike at their prey with their long beaks. Their varied carnivorous and piscivorous diet places it high up on the food web and makes them susceptible to adverse effects resulting from bioaccumulation of CoPECs.

The raccoon (*P. lotor*), a medium-sized mammal, is common throughout North America. Its preferred types of habitat are wetlands and suburban areas. The raccoon is known to consume aquatic invertebrates, fish, insects, mollusks, annelids, bird eggs, small passerine birds, small mammals such as squirrels, and plants (Chapman and Feldhamer 1982). Aquatic species may make up only a small portion of the raccoon diet if other sources of food (e.g., domestic or commercial refuse) are readily available. Foraging raccoons can be exposed to CoPECs in sediments and water, as well as in their diet.

Receptor profiles were developed for the mallard, great blue heron, and raccoon (Table 8). A receptor profile summarizes the parameters used to calculate an estimated daily dose of chemicals to a particular wildlife receptor. These parameters are body weight, normalized food ingestion rate, normalized sediment/soil ingestion rate, main dietary components, and foraging ranges. If information for both sexes was available, profiles were made for the female. In general, females tend to be more sensitive to chemicals because of reproductive differences.

The *Wildlife Exposure Factor Handbook* (U.S. EPA 1993) provides ranges of typical body weights and ingestion rates of food, as well as foraging areas, for the wildlife species used in this assessment. Nagy (2001) provides more current estimates of food ingestion rates for wild animals. Beyer et al. (1994) present sediment/soil ingestion rates for selected wildlife. These sources were used to develop exposure factors for the wildlife receptors considered in this SLERA. In some cases, the *Wildlife Exposure Factor Handbook* lists several values for a particular parameter. In general, the values selected are from studies of habitats that align with the habitats at this Site, from the same general region, if possible. In those cases, the study from which the value was selected is noted in Table 8.

The estimates of food ingestion rates presented by Nagy (2001) were used for the wildlife receptors in this assessment. The food ingestion rate for the mallard was estimated using the wet ingestion rate equation for omnivorous birds in Nagy (2001). The food ingestion rate for great blue heron was estimated using the wet ingestion rate equation for carnivorous birds in Nagy (2001). The food ingestion rate for the raccoon was estimated using the wet ingestion rate equation for omnivorous mammals in Nagy (2001). Food ingestion rates were normalized to body weight.

The percentages of soil in diets of the mallard and raccoon were taken from Beyer et al. (1994). However, Beyer et al. (1994) do not present percentages of soil in diets of the great blue heron. The percentage of sediment in the diet of the bald eagle was used as a surrogate for the great blue heron. The body-weight-normalized soil/sediment ingestion rate was calculated from the dry-weight-normalized food ingestion rate ($NFIR_{dry}$) equations and percentage of sediment/soil in diet provided by Nagy (2001).

The water ingestion rates for the wildlife receptors were estimated using the body-weight-normalized water ingestion rate equations published by Calder and Braun (1983).

The portion of the Hockanum River within the Site boundaries is considerably smaller than the home ranges for the mallard, great blue heron, and raccoon. However, it was conservatively assumed in this SLERA that these receptors would forage only within the Site portion of the river.

4.2.2 Screening-level Food-chain Models for Wildlife

Food-chain models were used to estimate the dietary exposure of the mallard, great blue heron, and raccoon to CoPECs in the portion of the Hockanum River within the Site boundaries. The food-chain modeling approach is standard and consistent with U.S. EPA's wildlife exposure guidance (U.S. EPA 1993). The food-chain model is a tool for estimating dietary exposure as a body-weight-normalized total daily dose.

The general model can be described by the following equation:

$$Dose_{CoPEC} = Dose_{food} + Dose_{soil/sediment} + Dose_{water}$$

where:

$Dose_{CoPEC}$ = total dose from all sources (mg CoPEC consumed/kg body weight of animal/day or mg/kg/day)

$Dose_{food}$ = dose from food (mg CoPEC consumed in food/kg body weight of animal/day)

$Dose_{soil/sediment}$ = dose from soil or sediment (mg CoPEC consumed in soil or sediment/kg body weight of animal/day)

$Dose_{water}$ = dose from water (mg CoPEC consumed in water/kg body weight of animal/day).

The daily dose of each CoPEC consumed by the receptor in each medium (e.g., sediment, food, or water) is estimated from the body-weight-normalized rates of consumption of each medium (e.g., daily food ingestion rate) and the concentration of CoPEC in that medium as follows:

$$Dose_M = IR_M \times C_M$$

where:

$Dose_M$ = dose from a particular medium (mg CoPEC/kg body weight/day)

IR_M = consumption rate of that medium normalized to body weight (kg medium consumed/kg body weight/day)

C_M = concentration of CoPEC in that medium (mg CoPEC/kg medium).

For species-specific input parameters, such as body weight and ingestion rate, there is a range of possible values that can be used. For example, adult body weights for any species are variable and may depend on several factors, including region of the country, habitat, local climate, and the availability of food. Similarly, the feeding behavior of receptor species can vary greatly, depending on geographic location and habitat type. For the purposes of this SLERA, single-value point estimates are used for all food-chain model exposure parameters.

The model provides an estimated total dietary exposure for CoPECs resulting from consumption of food and water, and the incidental ingestion of soil or sediment, on a mg/kg body-weight-day basis. The exposure estimate conservatively assumes that the entire receptor diet comes from within the Site and that 100% of a chemical in ingested food is absorbed. The maximum measured or estimated onsite CoPEC concentration was used to estimate dietary exposures, consistent with U.S. EPA guidance for conducting SLERAs (U.S. EPA 1997).

4.2.3 Exposure Point Concentrations

4.2.3.1 Sediment and Surface Water

An exposure point concentrations (EPC) is the concentration of a chemical in a given medium (e.g., sediment, water, and food item) that is used to represent the exposure concentration at the Site. EPCs are determined separately for each medium (sediment, water, and food items). For SLERAs, U.S. EPA recommends using the maximum concentration in each medium to represent the EPCs. The sediment and surface water EPCs used in the screening-level risk calculations were either the MDC, if the CoPEC was detected in that medium, or MRL, if the CoPEC was not detected in that medium but was still a CoPEC for the other medium (Table 9).

Total PAHs were evaluated as a CoPEC as well as the individual PAHs because some TRVs are available as the sum of individual PAHs (or Total PAHs). For the sediment total PAH EPC, the sum of the individual PAHs was calculated for each sample (if the sample contained a PAH that was not detected, one-half of the value of the reporting limit was used) and the maximum total PAH concentration of all the samples was used. For the surface water total PAH EPC, the MRLs were determined for each individual PAH and summed and used as the total PAH EPC since none of the measured PAHs were detected in the surface water samples.

4.2.3.2 Biota

Because concentrations of CoPECs in biota have not been measured at the Site, concentrations were estimated from EPCs for sediment (Table 9) using published bioaccumulation factors (BAFs) and trophic transfer factors (Table 10). These factors provide a conservative way to estimate biota concentrations from concentrations measured in sediment from the Site.

BAFs are quantitative relationships between sediment concentrations and biota derived from empirical measurement. The simplest BAFs are expressed as constant ratios between biota and sediment concentrations. Aquatic uptake of metals and organic substances is especially non-linear as a function of sediment concentration; therefore, the use of simple ratio BAFs was avoided if non-linear equations were available, and the model described below was employed, when possible.

The BAF model used is:

$$\log[biota] = B0 + B1 \times \log[sed]$$ [3]

where:

$\log[biota]$	=	Log, base 10, of the chemical concentration in aquatic invertebrate tissue (dry weight)
$B0$ and $B1$	=	Empirically derived, chemical-specific constants
$\log[sed]$	=	Log, base 10, of the chemical concentration in sediment (dry weight).

Sediment to plant tissue BAFs are literature-based BAFs for plants and a dry-to-wet conversion factor of 0.2 since plant tissues are typically 20% solids. Sources of literature BAFs for plants were U.S. EPA (2007) and Bechtel Jacobs Company LLC (1998a). BAFs are expressed as either a regression equation between sediment and tissue concentrations or as a factor applied to the sediment concentration, as provided in the source. These BAFs for plants were taken from terrestrial plant studies since BAFs are not widely available for aquatic plants. EPCs for plants were estimated using the maximum sediment concentrations and the sediment-plant BAF equations (Table 10).

Sediment to benthic invertebrate tissue BAFs are literature-based BAFs for benthic invertebrates (or soil invertebrates where BAFs for benthic invertebrates are unavailable) and a dry-to-wet conversion factor of 0.3 since benthic invertebrates are typically 30% solids. Sources of literature BAFs for invertebrates were U.S. EPA (2007) and Bechtel Jacobs Company LLC (1998b). BAFs are expressed as either a regression equation between soil and tissue concentrations or as a factor applied to the soil concentration, as provided in the source. No reliable BAFs or appropriate surrogates for benthic invertebrates were identified based on similar chemical properties for PAHs. The uptake of these chemicals by benthic invertebrates

[3] Some of the models are based on natural log normalized data, see Table 10.

was modeled by assuming a conservative BSAF of 1.0 (i.e., aquatic invertebrate tissue concentrations are assumed to be equal to sediment concentrations). EPCs for benthic invertebrates were estimated using the maximum sediment concentrations and the sediment-invertebrate BAF equations (Table 10).

Trophic transfer factors were used to estimate fish tissue concentrations from estimated benthic invertebrate concentrations. Since chemical exposure of fish is more closely linked to food ingestion than to exposure to sediments, trophic transfer factors were used to estimate fish body burdens from benthic invertebrate tissue concentrations at the Site. In addition, trophic transfer factors inherently take into account excretion, metabolism and/or biomagnification of chemicals. Fish concentrations were modeled using trophic transfer factors developed by U.S. ACE WES (Dillon et al. 1995). Dillon et al. (1995) summarized trophic transfer factors for several chemicals, including arsenic, cadmium, chromium, copper, lead, mercury, methyl mercury, nickel, vanadium, zinc, and total PAHs, among other chemicals. Chemicals with trophic transfer factors greater than 1 were considered to have the potential for biomagnification in aquatic systems. Dillon et al. (1995) demonstrated that trophic transfer factors correlate with log K_{OW}, (a value which describes how chemical partitions in water and organic phases [e.g., tissue]). Dillon's review found most inorganic and organic chemicals appear to have a low potential for trophic transfer. However, total and methyl mercury and arsenic (at higher trophic levels) have the potential to biomagnify.

Maximum trophic transfer factors for fish presented in Dillon et al. (1995) are presented in Table 10. Trophic transfer factors are expressed as a factor applied to the benthic invertebrate tissue concentration, as provided in the source. A trophic transfer factor was unavailable for barium; thus, a value of 1 is used as a surrogate because it is unlikely that this metal biomagnifies and a value of 1 is conservative. In other words, the barium concentration for benthic invertebrates was used as a surrogate for the fish concentration for barium. EPCs for fish were estimated using the maximum benthic invertebrate concentrations and the maximum trophic transfer factors (Table 10).

4.2.4 Toxicity Reference Value for Benthic Invertebrates, Fishes, and Amphibians

4.2.4.1 Benthic Invertebrates and Fishes

The same ecological SLs for sediment and surface water used in the CoPEC selection were used as TRVs in the assessment endpoints for benthic invertebrates (sediment SLs) and fishes (surface water SLs) since these represent conservative values appropriate for use in SLERAs per U.S. EPA guidance and guidelines (U.S. EPA 1997, 1998). These TRVs are described in Sections 3.4.1 and 3.4.2 and provided in Table 11 for CoPECs only.

4.2.4.2 Amphibians

Water benchmarks or values were developed to evaluate the potential for adverse effects on amphibians from exposure to surface water in the Hockanum River. U.S. EPA maintains and periodically updates the ECOTOXicology database (ECOTOX),[4] which contains single-chemical toxicity data for aquatic life, terrestrial plants, and wildlife. U.S. EPA derives these data from toxicity studies, predominately from the peer-reviewed literature, for aquatic life, terrestrial plants, and terrestrial wildlife.

ECOTOX was searched recently for toxicological data for amphibians. The following search parameters were used in an advanced database search:

- Taxonomic entries: animals, amphibians, frog, salamander, toad
- Chemical entries: metals, PAHs
- Concentration-based endpoint entries: LC/LDxx, EC/EDxx, IC/IDxx, LOEC, NOEC, NOEL, LOEL, MATC, LETC/ATCN, LETH
- Time-based endpoint entries: LTxx, ETxx
- Effect measurements entries: ecosystem group, growth group, population group, mortality group, reproduction group
- Test condition entries: lab tests, freshwater, any exposure types, and measured or unmeasured chemical concentrations
- Publication years: all.

The results of this search were downloaded and organized by chemical. The lowest available relevant effect level (e.g., LC/LDxx, EC/EDxx, IC/IDxx, LOEC, LOEL, MATC, LETC/ATCN, LETH) in the ECOTOX search for a given chemical was selected as the amphibian water value for that chemical. Table 11 shows the selected amphibian water values that were used as TRVs for amphibians (Appendix C provides details on the studies used to develop the amphibian water values).

While amphibian water values were developed for many of the CoPECs, there were not sufficient data to develop them for all of the CoPECs. Due to lack of relevant data, amphibian water values were not developed for 2-methylnaphthalene, acenaphthalene, acenaphthylene, benz(a)anthracene, benz(b)fluoranthene, benz(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, and phenanthrene.

[4] http://cfpub.epa.gov/ecotox/

4.2.5 Toxicity Reference Values for Wildlife

Wildlife TRVs for comparison to estimated dietary exposure to CoPECs were taken directly from the literature or derived from published studies on laboratory animals (Tables 12 and 13; derivation of the wildlife TRVs is provided in Appendix D). The chronic no-observed-adverse-effect level (NOAEL) was used as a conservative estimate of the adverse-effects threshold. The NOAEL is the highest dose administered during a chronic toxicity study that did not produce adverse toxic effects. The true effect threshold, under the tested exposure conditions, is somewhere above the NOAEL. At an exposure level equal to the NOAEL, no adverse effect is expected. As the concentration increases above the NOAEL, the probability of an effect occurring increases.

Because controlled laboratory experiments are rarely conducted with wildlife species, it is typically necessary to derive TRVs by extrapolating data from related laboratory or domestic species to the representative receptors. In this assessment, source studies were selected that considered survival, growth, reproductive, and developmental effects or other critical effects that would indicate overt impacts to individual organisms that may affect population size or stability. Studies incorporating chronic exposure durations, multiple exposure levels, and statistical evaluation of test results were selected preferentially.

No toxicity studies exist for the raccoon; therefore, NOAELs were derived from laboratory test animal (e.g., rat and mouse) studies using this allometric relationship described by Sample et al. (1996):

$$NOAEL_w = NOAEL_t \, [bw_t/bw_w]^{1/4}$$

where:

$NOAEL_w$ is the NOAEL for the wildlife species in question

$NOAEL_t$ is the NOAEL for the test species

bw_t is the body weight of the test species

bw_w is the body weight of the wildlife species in question.

Note that smaller animals will have larger NOAELs, because, according to Sample et al. (1996), the smaller animals tend to have higher metabolic rates and are more resistant to toxic chemicals. Using the study-derived NOAELs for the raccoon, which is larger than most of the laboratory test animals, would have underestimated risk had the study-derived values been used in the SLERA; hence, allometric adjustments from Sample et al. (1996) to the NOAELs are appropriate. Avian TRVs are not allometrically adjusted (Sample et al. 1996).

The avian and mammalian TRVs are summarized in Tables 12 and 13, respectively.

4.3 Results of Screening-Level Exposure Estimate and Risk Calculation

This section presents the results of the HQs for the four receptor groups and whether a BERA is required for any CoPECs and exposure pathway at the Site.

4.3.1 Screening-level Results for Benthic Invertebrates (Assessment Endpoint 1)

The screening-level risk assessment for benthic invertebrates was conducted by comparing the EPCs (maximum concentrations of CoPECs in the Hockanum River sediment near the Site) to sediment SLs, which were used as benthic invertebrates TRVs. All CoPECs, except for arsenic and benzo(b)fluoranthene, exceeded the sediment TRVs for benthic invertebrates (HQs ranged from 0.5 to 463) (Table 14). Barium had the highest HQ (463), followed by acenaphthylene (237). Other PAHs also had relatively high HQs. Copper had the second highest HQ for metals at 69. The remaining metals (arsenic, cadmium, chromium, mercury, nickel, and vanadium had relatively low HQs (0.7 to 3). All CoPECs, except for arsenic which had HQ was less than 1, should be carried forward into a BERA for benthic invertebrates. While the HQ for benzo(b)fluoranthene was less than 1, it will be carried forward into the BERA because PAHs are often assessed collectively for ecological risk. To obtain better estimates of exposure to CoPECs at the Site, sediment samples should be collected from the Site and evaluated in laboratory toxicity testing using a sensitive benthic invertebrate species.

4.3.2 Screening-level Results for Amphibians (Assessment Endpoint 2)

The screening-level risk assessment for amphibians was conducted by comparing the EPCs (maximum concentrations of CoPECs in the Hockanum River surface water near the Site) to amphibian values. None of the CoPECs exceeded the available amphibian values (all HQs < 1) (Table 15). However, amphibian values were unavailable for some PAHs, but those for which amphibian values were available, the HQs were very low (0.00002 to 0.002) suggesting the PAHs would not pose a risk to amphibians. Therefore, CoPECs at the Site do not appear to pose a risk to amphibians and this exposure pathway does not need to be carried forward into a BERA.

4.3.3 Screening-level Results for Fishes (Assessment Endpoint 3)

The screening-level risk assessment for fishes was conducted by comparing the EPCs (maximum concentrations of CoPECs in the Hockanum River surface water near the Site) to surface water SLs, which were used as TRVs for fishes. Barium (HQ = 14), cadmium (HQ = 8), copper (HQ = 1), lead (HQ = 2), benzo(a)anthracene (HQ = 2), benzo(a)pyrene (HQ = 4), and pyrene (HQ = 2) exceeded the surface water SLs for fishes (Table 15). However, cadmium, copper, lead, and all of the PAHs were not detected in any of the surface water samples.

Because of the elevated reporting limits for these chemicals, these CoPECs should be carried forward along with barium and zinc, which were detected above the SLs, into a BERA for fishes. To obtain better estimates of exposure of fishes to CoPECs at the Site, tissue samples of fishes should be collected from the Hockanum River and analyzed for CoPECs and compared to tissue-based effect levels for fishes.

4.3.4 Screening-level Results for Wildlife (Assessment Endpoint 4)

Food-chain models (Appendix E) for the mallard, great blue heron, and raccoon were used to estimate risk to wildlife receptors that use the portion of Hockanum River near the Site. The current conditions are expected not to change in the future; thus, the results for current conditions also apply to future conditions. Because concentrations of aquatic biota (plants, fish and benthic invertebrates) have not been collected from the Hockanum River, they were modeled using conservative sediment-biota uptake factors and trophic transfer factors from the literature. In accordance with U.S. EPA guidance and guidelines for conducting SLERAs (U.S. EPA 1997, 1998), EPCs used in the food-chain models were maximum concentrations in sediment, surface water, and biota, and it was assumed that wildlife receptors would spend 100% of their time at the Site. The results of the food-chain models found that chromium (HQ = 2) and vanadium (HQ =7) pose a potential risk to the raccoon, and PAHs pose a potential risk to the mallard (HQ = 9), great blue heron (HQ = 14), and the raccoon (HQ =9) (Table 16). Therefore, these chemicals and exposure pathways should be carried forward into a BERA for wildlife. To obtain better estimates of wildlife exposure to CoPECs, tissue samples of plants, fishes and invertebrates should be collected from the Hockanum River, analyzed for these CoPECs and used in site-specific food-chain models for the mallard, great blue heron, and raccoon.

4.3.5 Summary of Screening-level Results

Table 17 summarizes the results of the screening-level calculations, expressed as HQs, for all ecological receptors considered to use the Site portion of the Hockanum River. The ecological receptors with the greatest number of HQs above 1 were benthic invertebrates, followed by fish, and then wildlife. Therefore, risk to these receptors cannot be ruled out with the available information. However, all of the HQs for amphibians at the Site were below 1 and thus this receptor does not require further evaluation.

5 Uncertainty Analysis

Several sources of uncertainty are associated with the assumptions in this SLERA. These sources of uncertainty are common to the ERA process in general. Uncertainty is associated with the use of screening levels, TRVs, elevated analytical detection limits, selection of exposure parameters, and accumulation factors; these are discussed below. The magnitude of uncertainty differs among sources and can vary with CoPEC and receptor.

5.1 Uncertainties Associated with SLs and TRVs

The primary area of uncertainty for the SLERA is associated with conservative SLs and TRVs that may lead to an overestimation of risk to ecological receptors. SLs and TRVs are significant sources of uncertainty in SLERAs for the following reasons:

- Test conditions may not accurately mimic natural exposure
- Relative sensitivity of the receptor compared to the test species may be unknown
- Identification of the no-effect threshold is imprecise and depends on selected dose intervals
- Uncertainty factors applied in calculating some SLs and TRVs are generalized and ignore species-specific sensitivities
- Chronic no-effect thresholds have not been measured for all hazardous constituents and may need to be estimated from low-effect thresholds or acute exposure studies.

While these factors could lead to uncertainty in SLERA, that uncertainty results in conservative estimates of risk (e.g., overestimating risk), which is appropriate for the purposes of a SLERA. This means that additional assessments should be conducted using site-specific information and data to reduce the uncertainty and develop more realistic estimates of exposure and risk in a BERA.

5.2 Uncertainty Associated with CoPEC Selection

A number of analytes were retained as CoPECs based solely on their status as bioaccumulative chemical compounds (BCCs) (see the CoPEC selection tables, Tables B-1 and B-2 in Appendix B). The process for determining if a chemical was bioaccumulative was based on a U.S. EPA document on bioaccumulation (U.S. EPA 2000). CoPEC selection was based on comparison to protective screening criteria. Thus, to remain conservative, detected compounds with the potential to bioaccumulate, but below screening levels, were retained as COPECs if detected. Inclusion of these constituents as CoPECs may overestimate the potential risk.

A large number of chemicals lacked surface water SLs; however, none of these chemicals were detected in any of the surface water samples. In the case of sediment, two detected analytes (CT ETPH and carbazole) were detected in sediment samples but lacked sediment SLs. CT ETPH was retained as a CoPEC but this analyte consists of a number of chemicals that were evaluated individually in the SLERA. For carbazole, while there is no sediment SL for carbazole, this chemical was detected in only two of the nine sediment samples and is not a BCC; therefore, it was eliminated as a CoPEC.

For many undetected chemicals, there is often uncertainty as to whether they could elicit adverse ecological effects, because the detection limits for these chemicals exceed sediment and surface water SLs. This is largely because the SLs have been developed to be conservative using various often compounded uncertainty factors. Some of the analytes never detected in a given medium had MRLs in exceedance of the applicable SL (Appendix B). Analytes that were never detected in any media were not retained as CoPECs. This elimination may result in an underestimate of Site risk by an unknown amount. However, the presence of data reported as non-detected above a specific reporting limit in a data set has the potential to affect risk estimates because such data introduce uncertainty as the true concentration is somewhere between the reporting limit and zero. The underestimation of risk would likely be low because if the non-detected chemicals were actually site-related and present at levels of significant concern, they likely would have been found at concentrations above the detection limits at some point in the investigation.

5.3 Uncertainty Associated with Bioaccumulation Factors and Trophic Transfer Factors

Concentrations of CoPECs in biota have not been measured at the Site, and Site-specific sediment bioaccumulation tests were not conducted for this assessment. Instead, this assessment used BAFs for plants and invertebrates and trophic transfer factors derived from the literature. However, these literature-derived factors are recognized as being conservative, so it is likely that estimating exposure of wildlife to CoPECs in biota from the literature-derived accumulation or transfer factors led to an overestimate, rather than underestimate, of risk.

5.4 Uncertainty Associated with the Food-Chain Models

There are inherent uncertainties in the use of the food-chain model, because the model incorporates simplifying assumptions to represent a complex ecological system. For example, food-chain models assume that chemicals in food and incidentally ingested sediment are completely available to the receptor. This will overestimate risk for constituents for which only a fraction of the ingested dose is bioavailable.

The actual diets of the wildlife receptors include more diverse food types than are represented in this SLERA. This assessment assumes exposure from consumption of particular prey types can be estimated based on concentrations in particular food items representative of the prey type.

There is uncertainty in the ingestion rates of the wildlife receptors. However, studies were used that present conservative estimates of quantity of food and soil/sediment in the diet (Nagy 2001; U.S. EPA 1993; Beyer et al. 1994) to reduce the likelihood of underestimating risk.

5.5 Chemical Concentrations Upstream of the Site in Hockanum River

The Site is located in an urbanized watershed and the Hockanum River receives inputs from several point and non-point sources. To investigate whether off-site concentrations of chemicals in sediments and surface waters could be influencing chemical concentrations in sediments and surface waters near the Site, Tighe & Bond collected sediment and surface water samples from five locations in the Hockanum River upstream of the Site (Figure 11) in 2020. The sample collection and analysis is described below (Section 5.5.1). Screening-level calculations of exposure and risk were made for the upstream data using the same methods as described for the Site data in Section 4; the results for the upstream data are described below (Section 5.5.2).

5.5.1 Tighe & Bond Upstream Sediment and Surface Water Sampling 2020

On October 21, 2020, Tighe & Bond collected sediment samples from five locations (SED-101, SED-102, SED-103, SED-104, and SED-105) upstream of the Site. The upstream locations were selected by Exponent, Inc. and Tighe & Bond based on visual inspection of the sediment substrate and its similarity to sediment substrates near the Site. Sediment was collected using decontaminated stainless-steel hand sampling tools from within the top six inches of the sediment surface (surficial samples). The sediment samples were analyzed for CT ETPH, 15 metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), 17 PAHs, grain size, and total organic carbon.

On October 21, 2020, Tighe & Bond collected surface water samples from two locations (SW-100 and SW-101) in the Hockanum River. The surface water stations SW-100 and SW-101 were collocated with two of the upstream sediment SED-101 and SED-104 stations, respectively (Figure 11). The surface water samples were analyzed for CT ETPH, 15 total and dissolved metals (antimony, arsenic, barium, beryllium, cadmium, chromium (total), copper, lead mercury, nickel, selenium, silver, thallium, vanadium, and zinc), 17 PAHs, and water hardness.

Several chemicals were detected in sediment and surface water located upstream of the Site. Tables 18 and 19 present the summary statistics for concentrations of chemicals in upstream sediment and surface water, respectively.

5.5.2 Screening-Level Exposure Estimate and Risk Calculation for Upstream Data

5.5.2.1 Exposure Point Concentrations for Upstream Data

Table 20 compares the EPCs for the upstream sediment and surface water samples to that for the Site EPCs for sediment and surface water data. The EPCs for both data sets were calculated either as the MDC or the MRL. The EPCs for the Site sediment data were higher than those for the upstream sediment data. However, the Site surface water EPCs were very similar to the EPCs for the upstream surface water data, with some exceptions due to slightly higher reporting limits in the upstream samples.

5.5.2.2 Results of Screening-level Ecological Risk Assessment using Upstream Data

Using the upstream EPCs, HQs were calculated for benthic invertebrates, aquatic life, and wildlife to assess whether upstream concentrations could lead to potential risk (as indicated by HQs > 1) (see Appendix F for the supporting tables for this analysis). HQs for many Site CoPECs, including barium, cadmium, lead, vanadium, zinc and most of the PAHs, were above 1 in the at least one of the assessments for benthic invertebrates, aquatic life, and wildlife upstream of the Site (Table 21). This indicates that background sediments and surface water upstream of the Site contain CoPECs at concentrations that could present possible risk from current and historical inputs to the Hockanum River. These results suggest that the assumptions used in the SLERA are quite conservative (reasons discussed above in this section). The background sediment results also could suggest that concentrations of chemicals upstream above screening levels could be influencing chemical concentrations downstream via sediment transport and deposition at the Site.

6 Summary and Conclusions

On behalf of Eversource, Exponent, Inc., under contract to Tighe & Bond, has prepared this SLERA for the Rockville Former MGP site located at 13 Maple Street/West Main Street in Rockville, Vernon, Connecticut. This SLERA was developed as part of the Phase III ESA to assess potential exposure pathways to ecological receptors at the Hockanum River at the Site, which are being completed under the CTDEEP VRP.

The Site encompasses 3.43 acres this is comprised of two parcels of land. The first parcel encompasses 2.88-acres and is located at 13 Maple Street. The parcel is developed for use as an active substation (Rockville 14W) and includes grassed yard and brush/wooded areas on the northern bank of the Hockanum River. The MGP footprint was located primarily in the central portion of the 13 Maple Street Parcel. The second parcel is a 0.55-acre parcel located along West Main Street. The Hockanum River is located this parcel and the property is undeveloped and overgrown and wooded areas are located along the southern riverbank (Figure 2 and 3).

The Hockanum River is classified by CTDEEP as Class B waters, meaning that it is designated for use as navigation, recreation, industrial and agricultural water supply, and potential habitat for fish and other aquatic life and wildlife. Based upon Phase III ESA investigation, the Hockanum River is a “losing stream”, where the stream recharges to groundwater at the Site. Groundwater flows northward away from the Hockanum River at the former MGP Site and Rockville 14W substation. The river receives stormwater inputs from two stormwater outfalls on-site as well as from upstream sources. Two historic outfall pipes were also identified based upon historical substation mapping and two outfalls were potentially associated with the former MGP along the northern bank of the river at the Site. An outfall believed to be associated with the former Hockanum Mill is located 270 ft north of the Site at Maple Street on the eastern site boundary.

Historically, the Hockanum River was integral to the industrial development of Rockville. The river was dammed and re-channelized for waterpower for multiple textile mills upstream of the site. Fill materials were likely used during initial develop development of the area based upon site investigations. The textile mills operated from the early 1800s through the World War II era with operations declining in the following decades. The mills generated textile processing wastes that could have potentially been discharged textile production waste materials to the river as part of operations. The MGP operated from circa 1863 until circa mid-1930s after which the Site appears to have been primarily used for manufactured gas storage until the 1950s.

The Site is located in an area of mixed residential with some commercial use to the south along West Main Street including a home heating oil distributor with aboveground oil tank, Gottier Fuel, which is located at the intersection of Maple Street and West Main Street, directly upstream of the Site. The facility maintains a large above-ground heating oil tank for fuel oil delivery trucks.

The ecological conceptual site model identified primary sources of CoPECs for on-site historic fill and outfall pipes from the MGP and the historic outfall pipes (including the Hockanum Mill) associated with subsurface piping at the adjacent to the substation. Off-site sources for stormwater runoff and impacted sediments that could impact river ecological receptors including benthic invertebrates, amphibians, fishes, and wildlife (Figure 9).

The SLERA identified several CoPECs, including PAHs, barium, cadmium, chromium, copper, lead, mercury, nickel, vanadium and zinc, present at concentrations in sediment and/or surface waters that resulted in HQs (quantitative risk estimates) in exceedance of 1. Upstream sediment and/or surface water samples contained similar PAHs and some similar metals (barium, cadmium, lead, and zinc) present at concentrations that resulted in HQs in exceedance of 1. ETPH was retained as a CoPEC for sediment and surface waters collected on-site and upstream but was assessed under risk from PAH compounds.

At the end of the screening-level exposure estimate and risk calculation step, a scientific/ management decision point is reached. Per U.S. EPA guidance (U.S. EPA 1997), the weight of evidence is considered to decide among the following:

- There is adequate information to conclude that ecological risks are negligible, and therefore, there is no need for remediation based on ecological risk.
- The information is inadequate to make a decision at this point, and the ERA process will continue.
- The information indicates a potential for adverse ecological effects, and a more thorough assessment is warranted.

Based on the screening-level exposure estimate and risk calculations, Exponent has determined that the last conclusion list above has been reached for the Site. In other words, the available information indicates a potential for adverse ecological effects from CoPECs in the Hockanum River portion of the Site to benthic invertebrates, fishes, and semi-aquatic wildlife, which requires further evaluation in a BERA. However, potential exposure and risk to amphibians at the Site does not require further evaluation.

It is important to note that chemical concentrations of CoPECs were also detected in upstream Hockanum River sediment and surface water samples at concentrations above ecological screening levels. These represent on-going sources of CoPECs that could likely be influencing chemical concentrations downstream at the Site. This also suggests that the risk assumptions used in the SLERA for on-site ecological receptors are quite conservative. Therefore, careful consideration should be given with regards to the future BERA in light of elevated concentrations of a number of chemicals found in the Hockanum River upstream of the Site.

Exponent recommends completing the BERA to assess the potential on-site ecological risk from CoPECs within the Hockanum River at the Site. For the BERA, sediment samples should be collected from the Site and evaluated in laboratory toxicity testing using a sensitive benthic invertebrate species to obtain better estimates of benthic invertebrate exposure to CoPECs at the Site. Fish tissue samples should also be collected from the Hockanum River and analyzed for CoPECs and compared to tissue-based TRVs for fishes. In addition, tissue samples of plants,

fishes (same as those for the fishes TRVs comparisons), and invertebrates should be collected from the Hockanum River, analyzed for CoPECs, and used in site-specific food-chain models for the wildlife species.

7 References

Bechtel Jacobs. 1998. Biota sediment accumulation factors for invertebrates: Review and recommendations for the Oak Ridge Reservation. BJC/OR-112. Oak Ridge National Laboratory.

Beyer, W.N., E. Conner, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. J. Wildl. Manag. 58:375–382.

Bechtel Jacobs. 1998a. Empirical models for the uptake of inorganic chemicals from soil to plants. BJC/OR-133. Oak Ridge National Laboratory.

Bechtel Jacobs. 1998b. Biota sediment accumulation factors for invertebrates: Review and recommendations for the Oak Ridge Reservation. BJC/OR-112. Oak Ridge National Laboratory.

Buchman, M.F. 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle WA, Office of Response and Restoration Division, NOAA, 34 p.

Calder, W.A., and E.J. Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 224:R601-R606.

Chapman, J.A., and G.A. Feldhamer. 1982. Wild Mammals of North America: biology, management, and economics. Johns Hopkins University Press.

CT DEEP. 2011. Numerical Water Quality Criteria for Chemical Constituents. State of Connecticut Department of Environmental Protection. Bureau of Water Protection and Land Reuse Planning and Standards Division, 2011 Connecticut Water Quality Standards (CWQS).

Dillon, et al. 1995. Trophic transfer and biomagnification potential of contaminants in aquatic ecosystems. Environmental Effects of Dredging Technical Notes US Army Engineer Waterways Experiment Station. EEDP-01-33. January.

Nagy, K.A. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutr. Abst. Rev. Ser. B 71:21R–31R.

Northeast Utilities Service Company. 1992. Manufactured Gas Plant Site Investigation: Rockville. March.

Northeast Utilities Service Company. 1995. Rockville MGP Site Field Summary Report (1994). Submitted to CDM Federal Programs Corporation and Connecticut Department of Environmental Protection. April.

Sample, B.E., R.L. Hinzman, B.L. Jackson, and L. Baron. 1996. Preliminary assessment of the ecological risks to wide-ranging wildlife species on the Oak Ridge Reservation. 1996 Update. DOE/OR/01-1407&D2, ORNL.

Suter, G.W., II and C.L. Tsao. 1996. Toxicological benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 revision. ES/ER/TM-96/R2. Oak Ridge National Laboratory.

Terres, J.K. 1980. The Audubon Society encyclopedia of North American birds. Alfred A. Knopf, New York.

Tighe & Bond. 2017. Phase I Environmental Site Assessment, Eversource Former Rockville MGP Site, 13 Maple Street/West Main Street, Rockville, Vernon, CT. March.

U.S. EPA. 1992. Framework for ecological risk assessment. EPA 630/R-92-001. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC.

U.S. EPA. 1993. Wildlife exposure factors handbook. Volumes I and II. EPA 600-R-93-187. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1994. Final Site Inspection Report for Northeast Utilities-Vernon, Vernon, Connecticut. CERCLIS No. CTD983870353. TDD No. 9304-40-ACS.

U.S. EPA. 1996. Ecotox Thresholds. ECO Update. Publication 9345.0-12FSI. EPA 540/F-95/038. Office of Solid Waste and Emergency Response. January.

U.S. EPA. 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. Interim Final. EPA/630/R-92/001 U.S. Environmental Protection Agency, Environmental Response Team, Edison, NJ. February.

U.S. EPA. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002F. U.S. Environmental Protection Agency, Washington, DC. April.

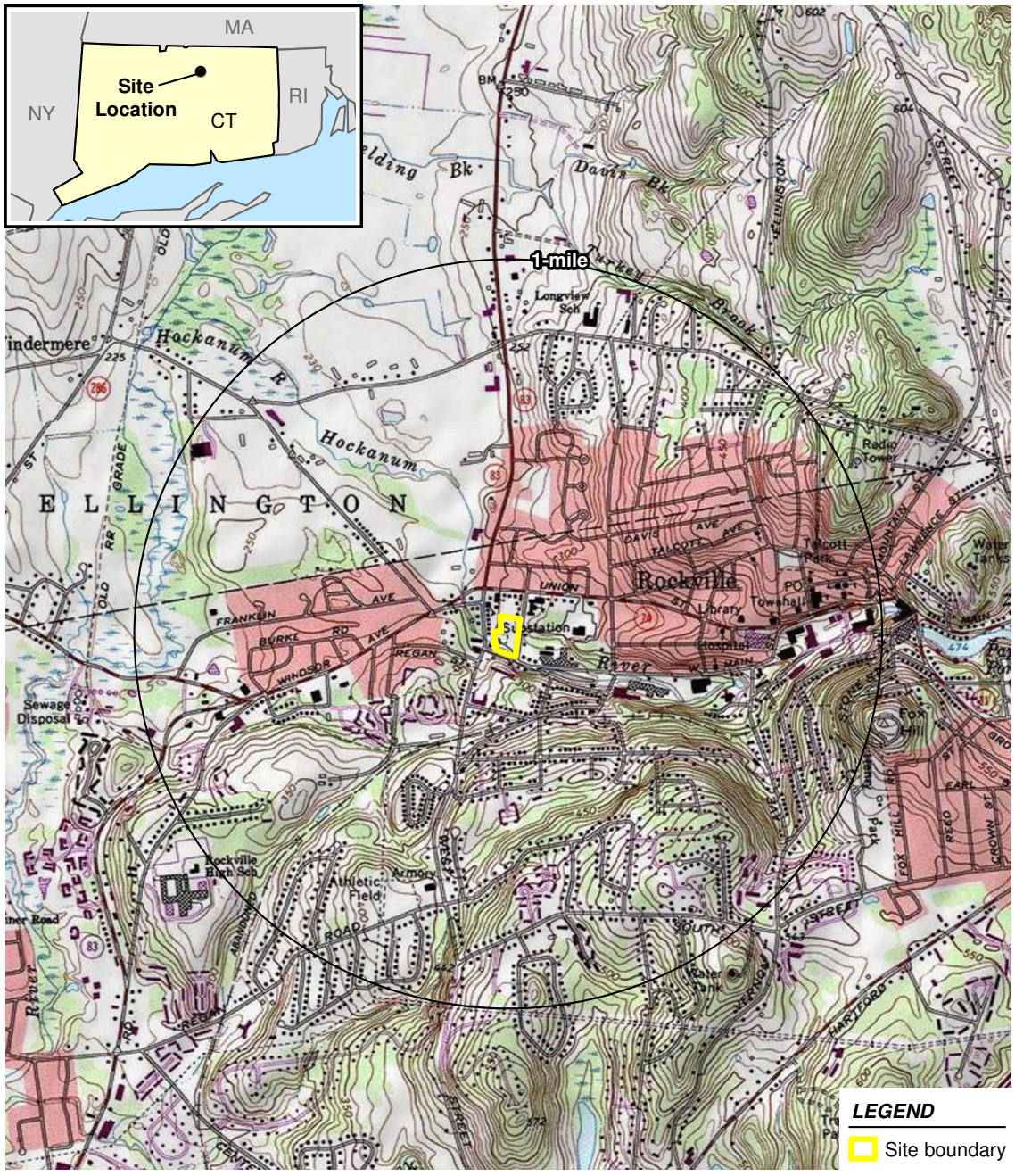
U.S. EPA. 2000. Bioaccumulation testing and interpretation for the purpose of sediment quality assessment: status and needs. EPA-823-R-00-001, Office of Water and Office of Solid Waste, Washington, DC. February.

U.S. EPA. 2003. Region 5, RCRA Ecological Screening Levels. August. https://archive.epa.gov/region5/waste/cars/web/pdf/ecological-screening-levels-200308.pdf

U.S. EPA. 2006. Region III BTAG. Freshwater Sediment and Surface Water Screening Benchmarks. https://www.epa.gov/risk/freshwater-sediment-screening-benchmarks; https://www.epa.gov/risk/freshwater-screening-benchmarks

U.S. EPA. 2007. Ecological soil screening levels (Eco-SSLs) for polycyclic aromatic hydrocarbons (PAHs), Interim final. U.S. Environmental Protection Agency, OSWER Directive 9285.7-78. June.

Figures



Source:
Topographic basemap from ESRI ArcGIS provided service, USA_Topo_Maps.
Last accessed September 18, 2020.

Figure 1. Site location map, Rockville Former MGP Site, Rockville, Vernon, Connecticut

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Source:
Aerial photograph from USGS (2016).

Figure 2. Aerial photograph, Rockville Former MGP Site, Rockville, Vernon, Connecticut

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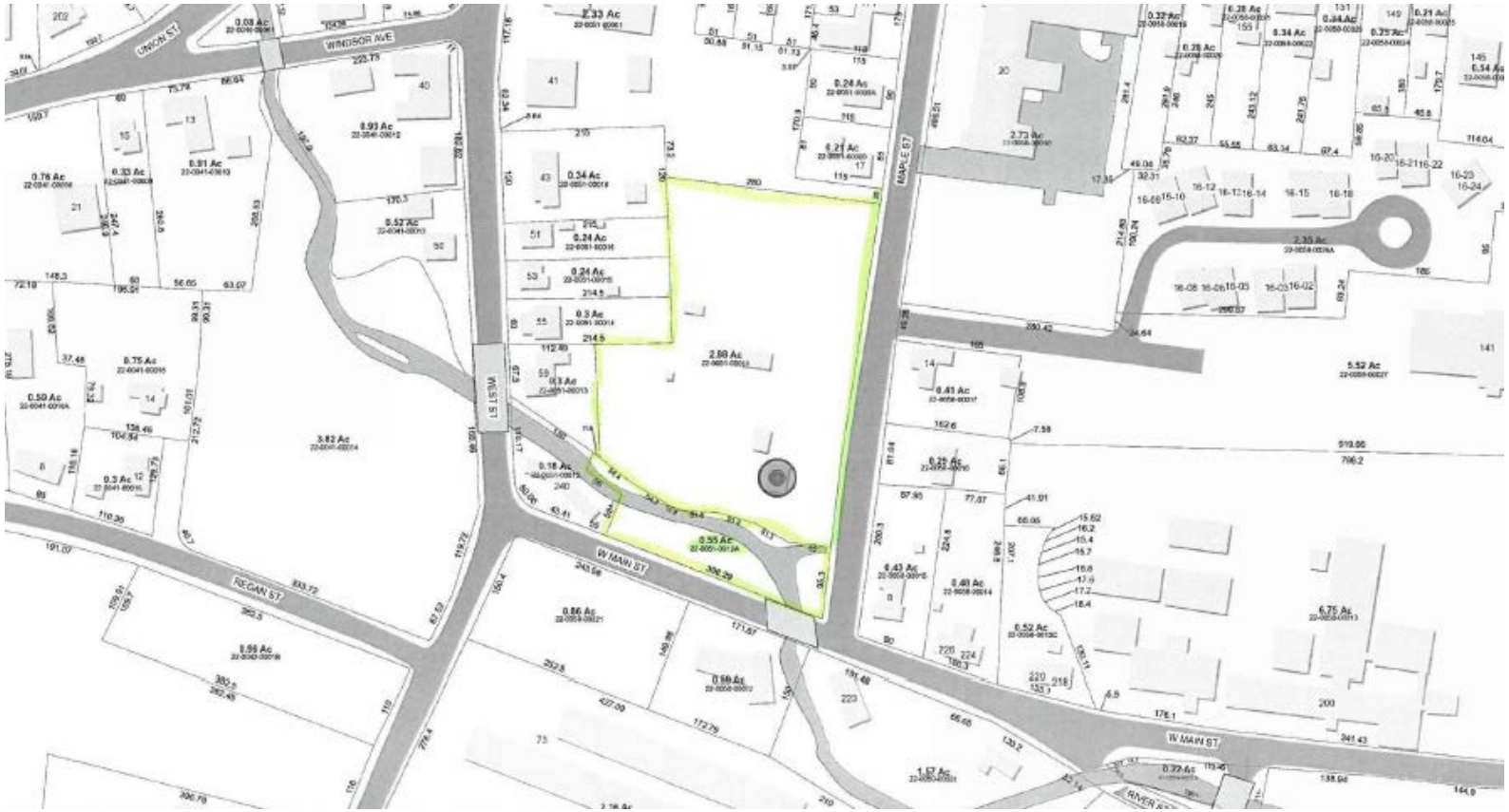
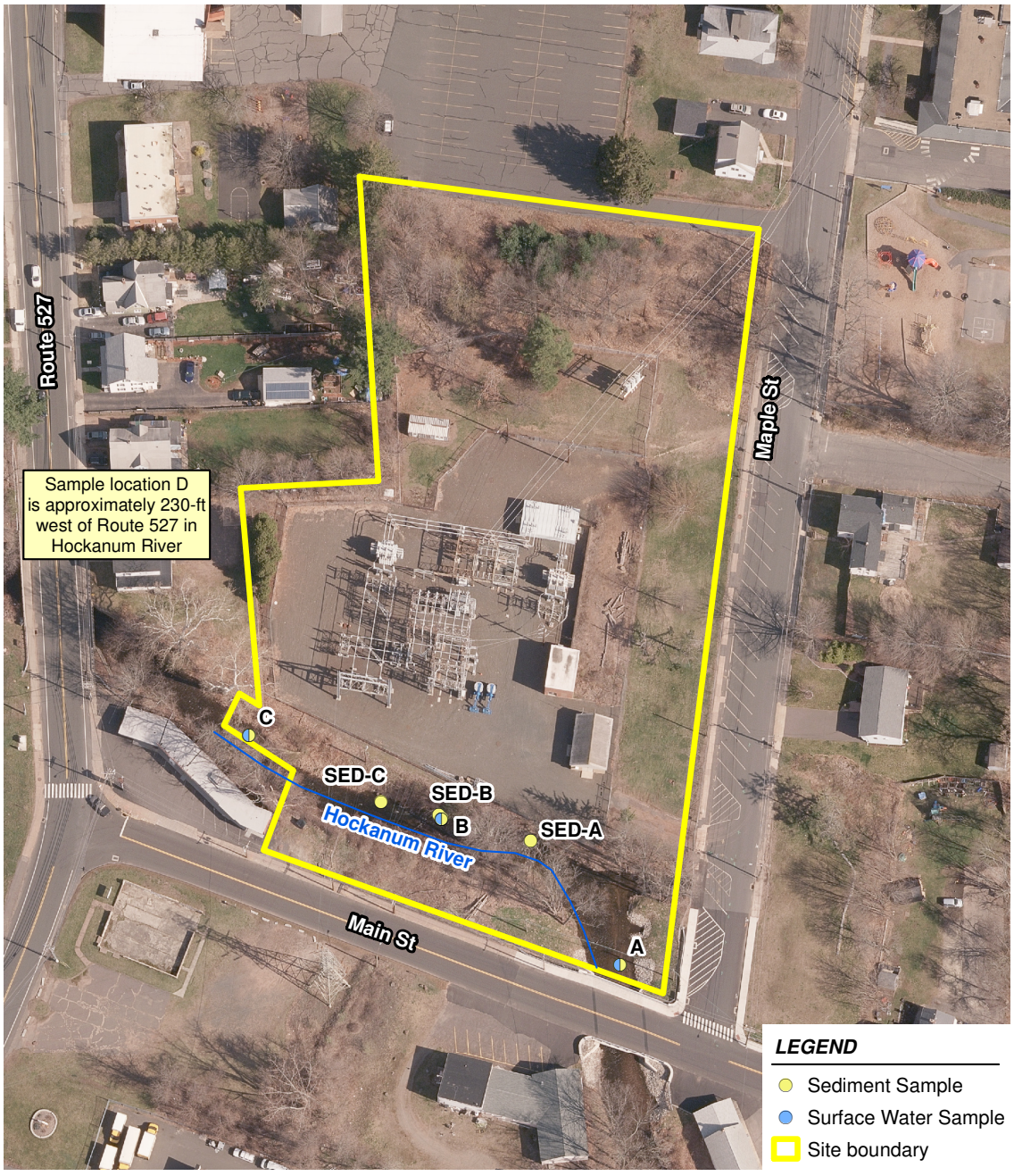


Figure 3. Parcels of land that comprise the Rockville Former MGP Site, Rockville, Vernon, Connecticut



Source:
Aerial photograph from USGS (2016).

Figure 4. Historical sediment and surface water sample location in the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

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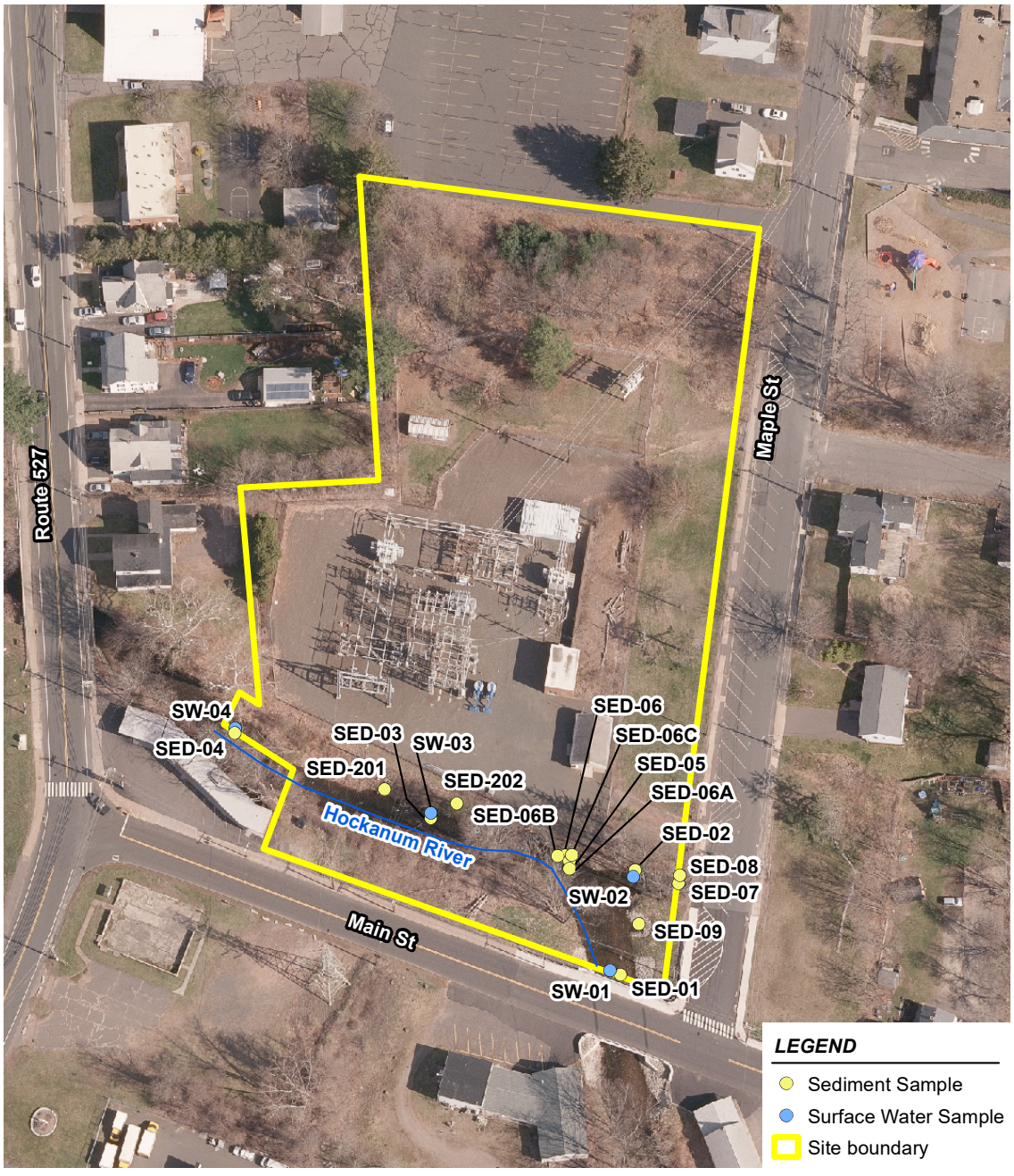

Figure 5. Current sediment and surface water sample locations in the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

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March 30, 2021 | \\befile\pfs\20\2000174.000-Vernon Connecticut Former MGP\GIS\projects\Current sample locations.mxd

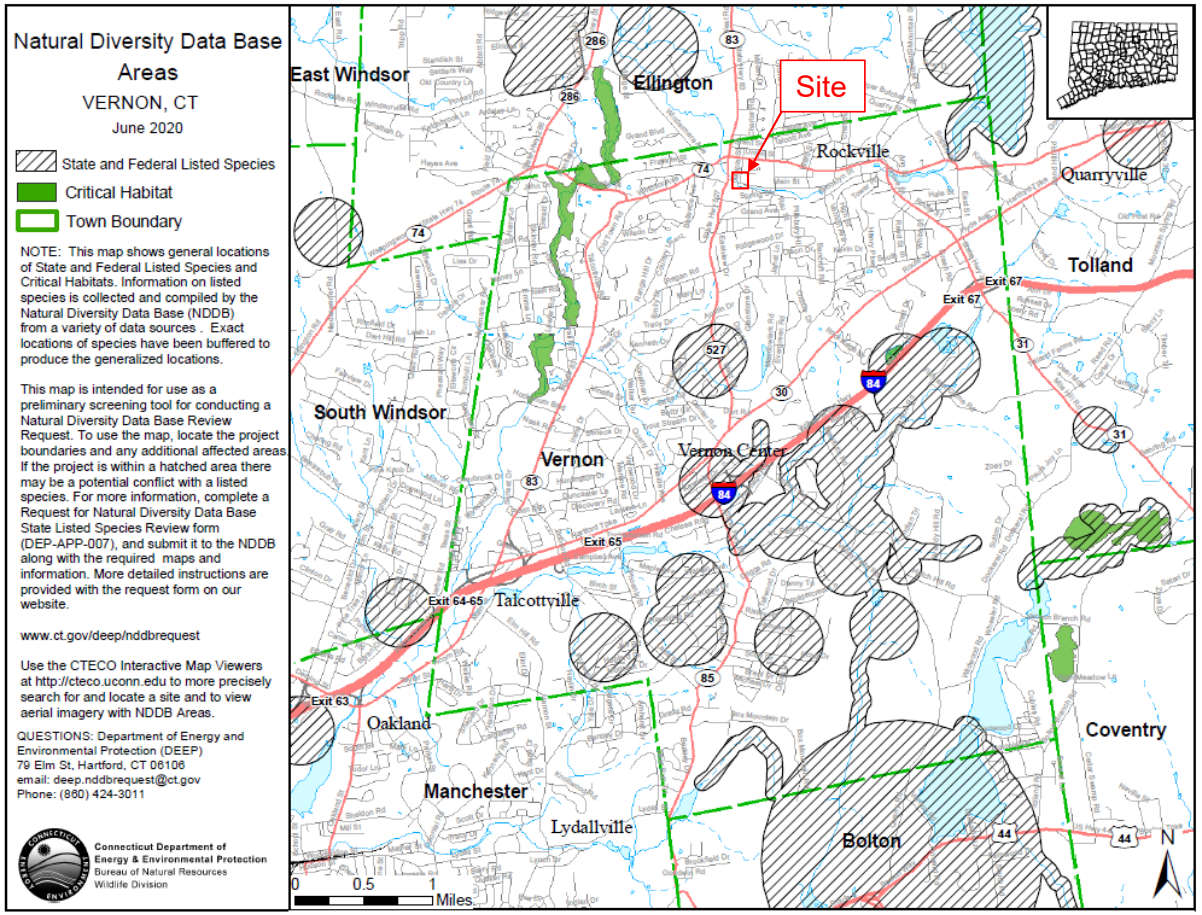

Figure 6. Natural Diversity Data Base Areas relative to the Rockville Former MGP Site, Rockville, Vernon, Connecticut

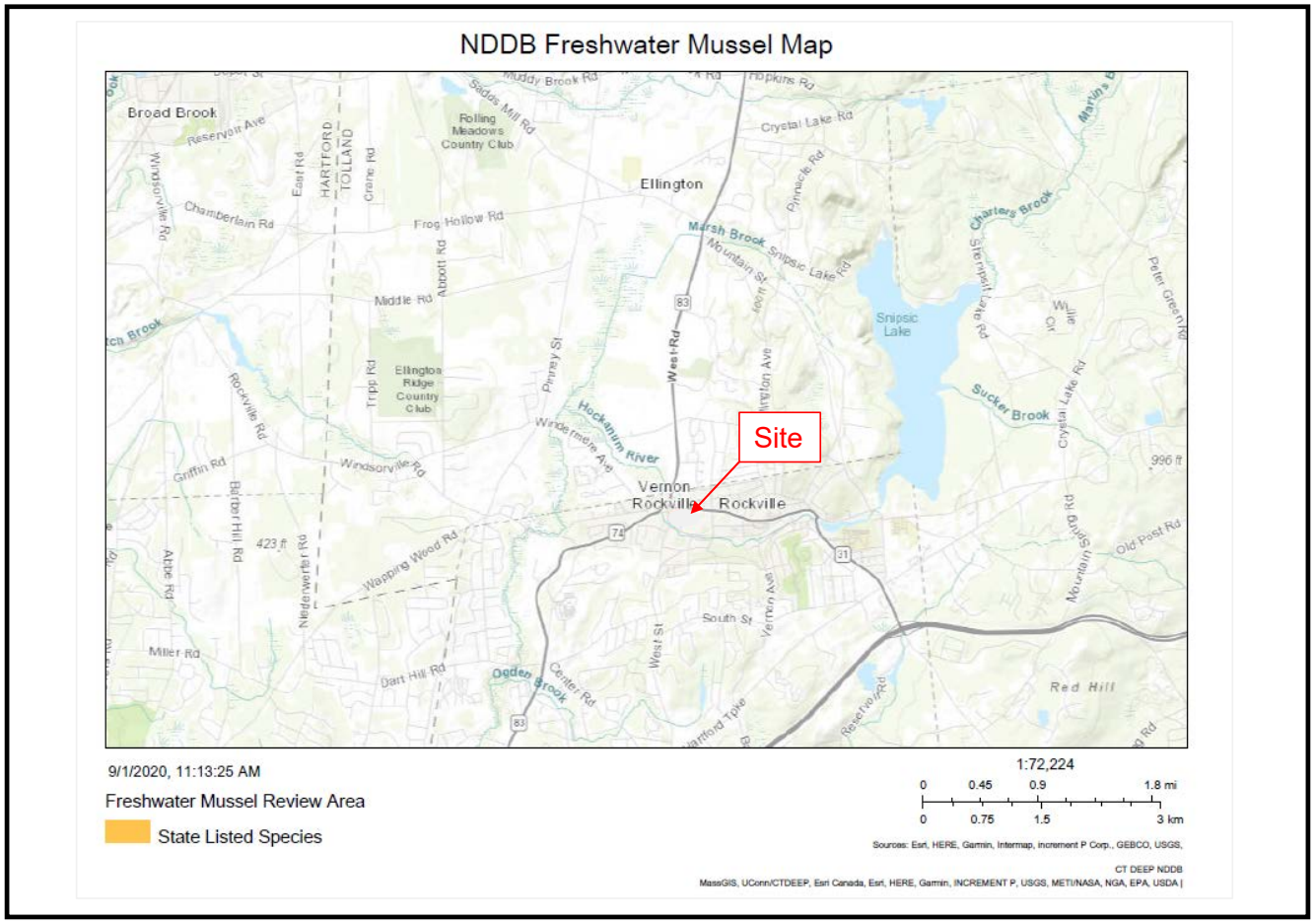

Figure 7. Natural Diversity Data Base freshwater mussel map near the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Note that there are no state-listed freshwater species shown near the Site.

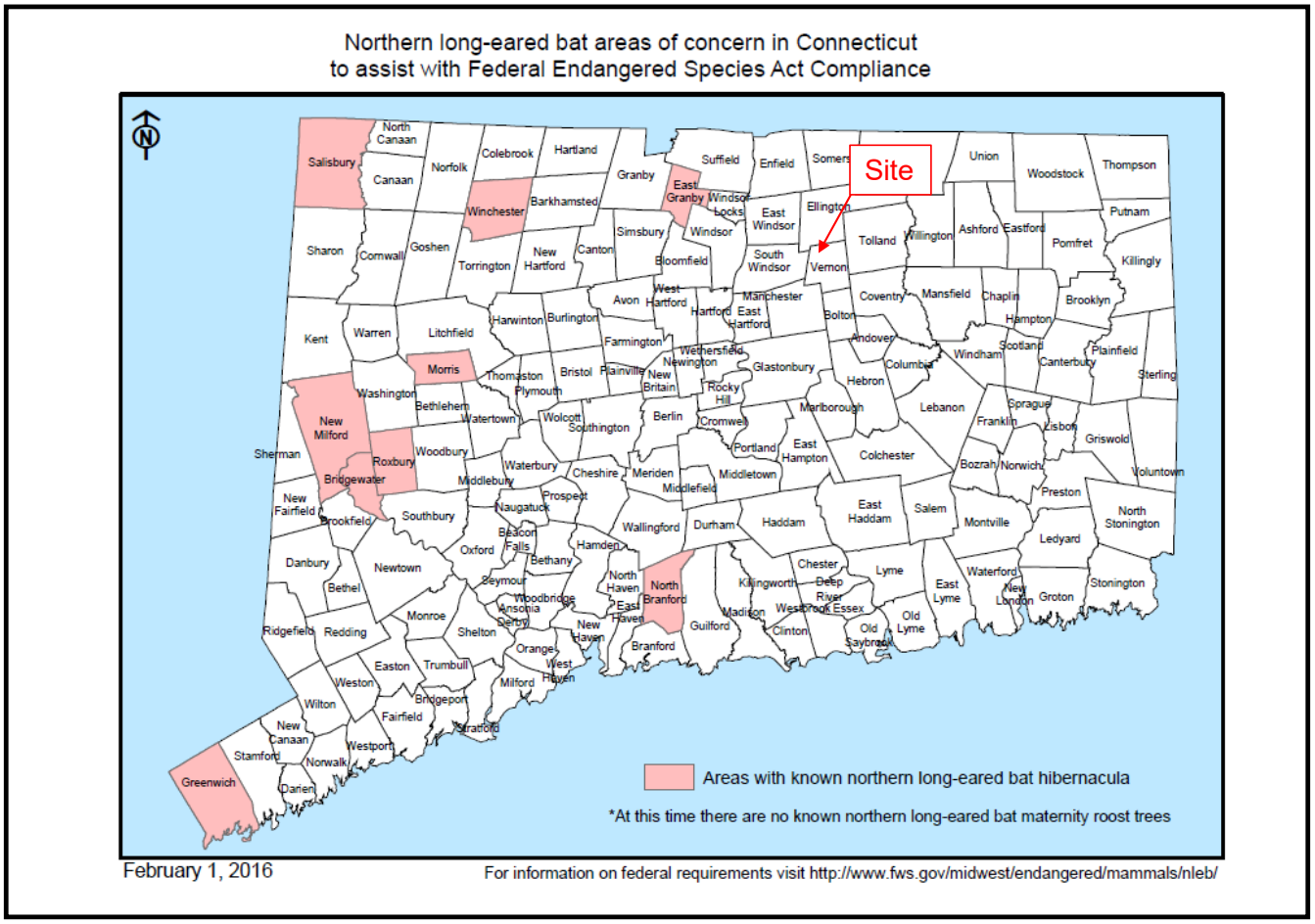

Figure 8. Locations of northern long-eared bat areas in Connecticut relative to the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Note that there are known northern long-eared bat hibernacula (places of hibernation) near the Site.

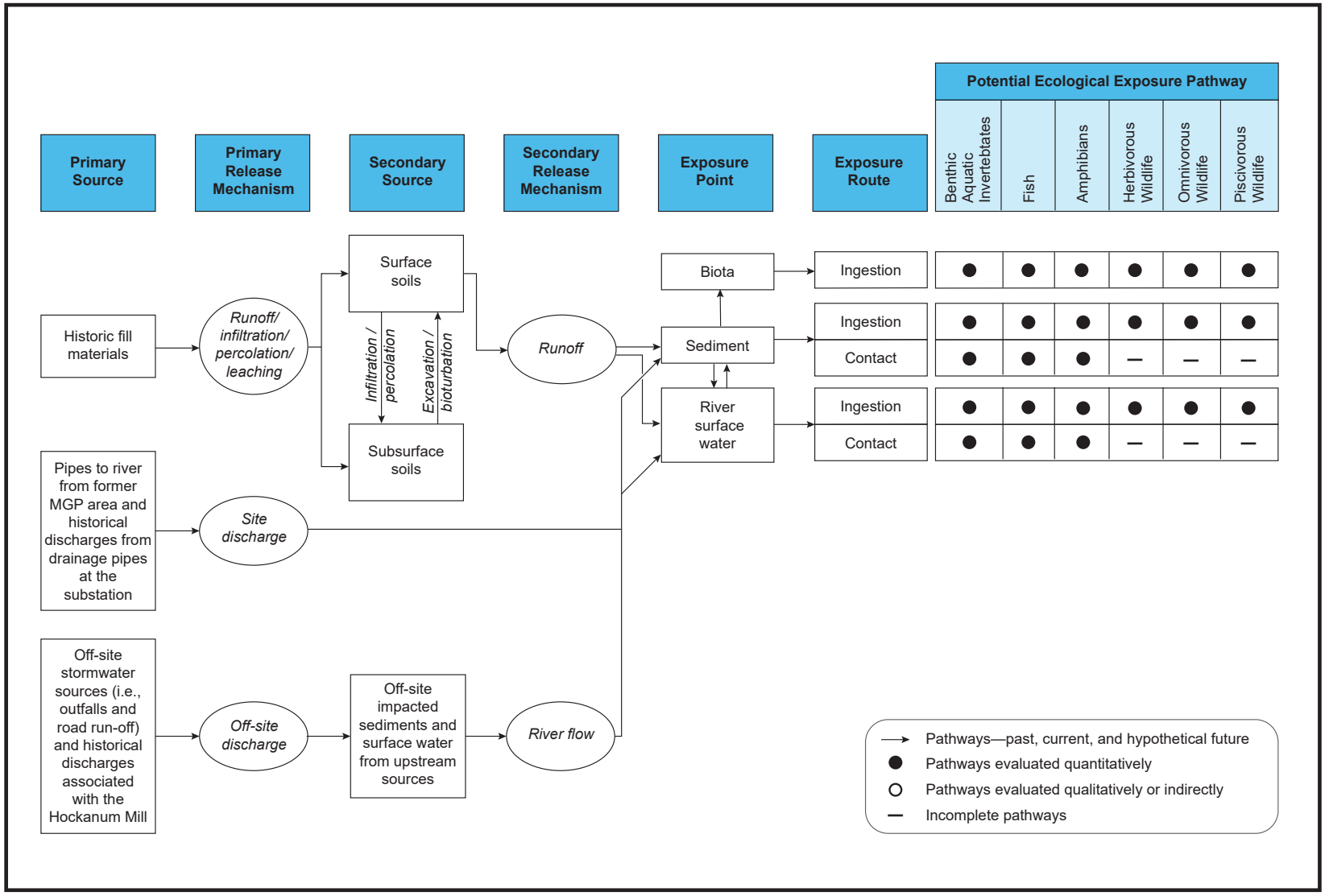

Figure 9. Ecological conceptual site model for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

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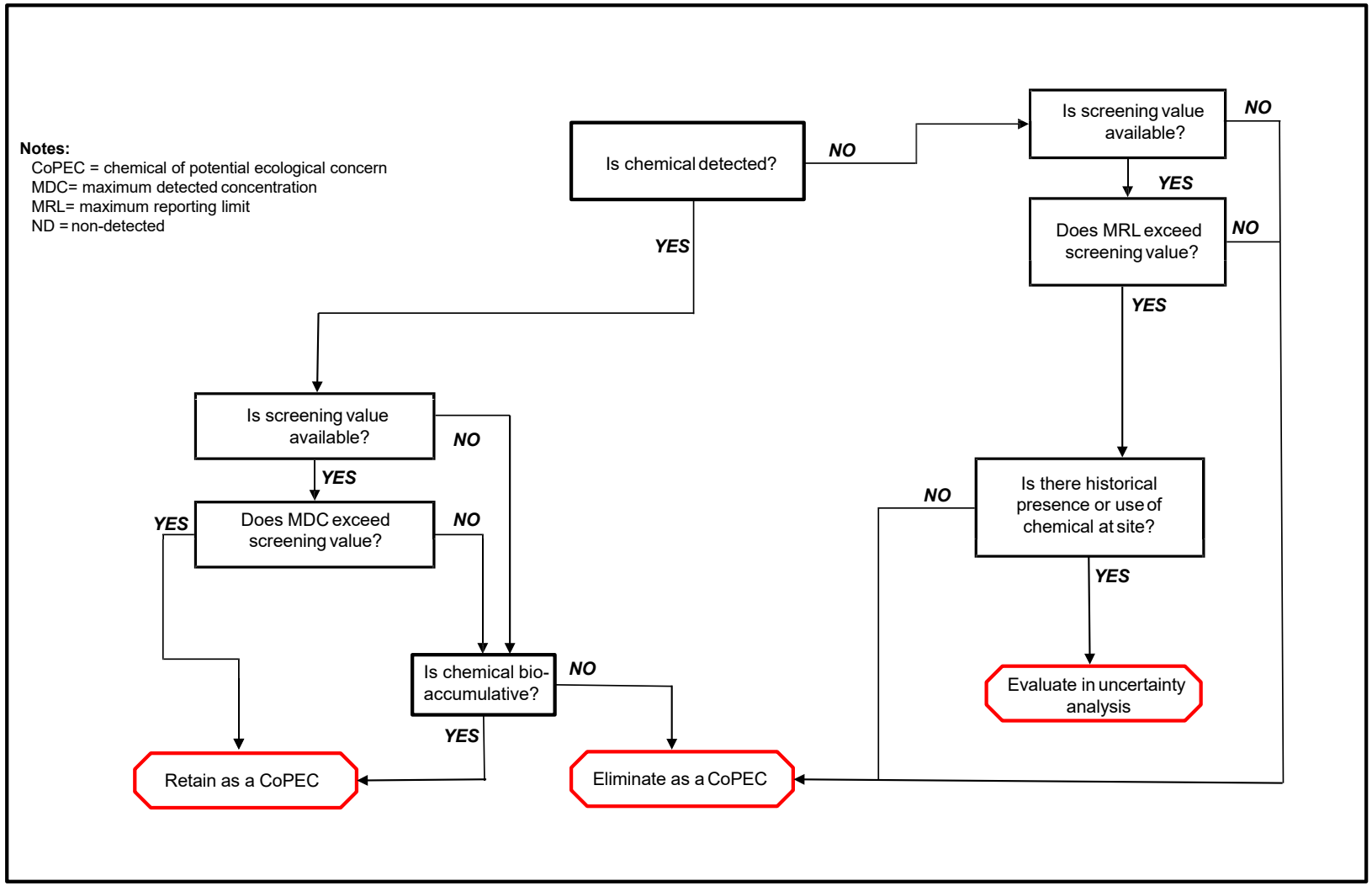

Figure 10. Selection process for chemical of potential ecological concern in sediment and surface water, Rockville Former MGP Site, Rockville, Vernon, Connecticut

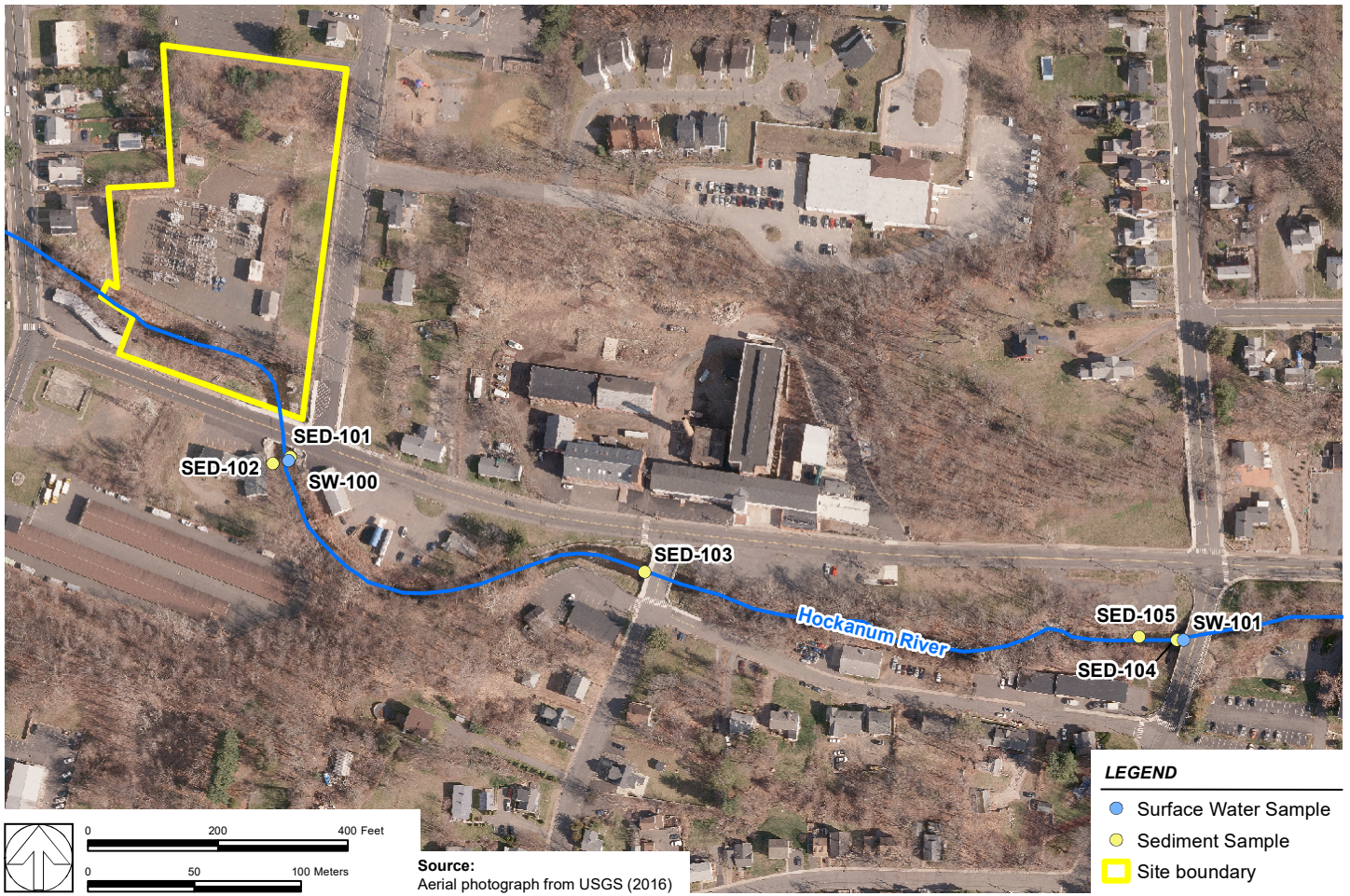

Figure 11. Current sediment and surface water sample locations in the Hockanum River upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

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March 1, 2021 | \\befile\pfs\20\2000174.000-Vernon Connecticut Former MGP\GIS\projects\sample locations.mxd

Tables

Table 1. Summary statistics of chemistry data for sediment samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)
CT ETPH	11	9	1400	290
Antimony	11	0	NA	22
Arsenic	11	8	7.3	0.85
Barium	11	11	324	NA
Beryllium	11	0	NA	1.8
Cadmium	11	4	2.9	1.4
Chromium (Total)	11	11	66.4	NA
Copper	14	14	2190	NA
Lead	11	11	267	NA
Mercury	11	3	0.21	0.03
Nickel	11	11	41.6	NA
Selenium	11	0	NA	8.9
Silver	11	0	NA	2.2
Thallium	11	0	NA	20
Vanadium	11	11	109	NA
Zinc	11	11	606	NA
Cyanide (Total)	6	0	NA	0.61
Aroclor-1016	11	0	NA	0.44
Aroclor-1221	11	0	NA	0.44
Aroclor-1232	11	0	NA	0.44
Aroclor-1242	11	0	NA	0.44
Aroclor-1248	11	0	NA	0.44
Aroclor-1254	11	0	NA	0.44
Aroclor-1260	11	0	NA	0.44
Aroclor-1262	11	0	NA	0.44
Aroclor-1268	11	0	NA	0.44
PCBs (Total)	11	0	NA	0.44
Tetrachlorobenzene, 1,2,4,5-	9	0	NA	3
Diphenylhydrazine, 1,2-	9	0	NA	4.3
Trichlorophenol, 2,4,5-	9	0	NA	3
Trichlorophenol, 2,4,6-	9	0	NA	3
Dichlorophenol, 2,4-	9	0	NA	3
Dimethylphenol, 2,4-	9	0	NA	3
Dinitrophenol, 2,4-	9	0	NA	4.3
Dinitrotoluene, 2,4-	9	0	NA	3
Dinitrotoluene, 2,6-	9	0	NA	3
Chloronaphthalene, 2-	9	0	NA	3
Chlorophenol, 2-	9	0	NA	3
Methylnaphthalene, 2-	11	2	0.79	3
Methylphenol, 2-	9	0	NA	3
Nitroaniline, 2-	9	0	NA	4.3
Nitrophenol, 2-	9	0	NA	3
Methylphenol, 3&4 (Cresol, m&p-)	9	0	NA	4.3
Dichlorobenzidine, 3,3-	9	0	NA	3
Nitroaniline, 3-	9	0	NA	4.3
Dinitro-2-methylphenol, 4,6-	9	0	NA	4.3

Table 1. Summary statistics of chemistry data for sediment samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)
Bromophenyl Phenyl Ether, 4-	9	0	NA	4.3
Chloro-3-methylphenol, 4-	9	0	NA	3
Chloroanilne, p- (4-Chloroaniline)	9	0	NA	3
Chlorophenyl-phenylether, 4-	9	0	NA	3
Nitroaniline, 4-	9	0	NA	6.9
Nitrophenol, 4-	9	0	NA	3
Acenaphthene	11	3	1.3	3
Acenaphthylene	11	8	1.4	3
Acetophenone	9	0	NA	3
Aniline	9	0	NA	4.3
Anthracene	11	7	3.3	3
Benzo(a)anthracene	11	10	7.2	1.5
Benzidine	9	0	NA	3
Benzo(a)pyrene	11	11	6.1	NA
Benzo(b)fluoranthene	11	10	5.3	3
Benzo(g,h,i)perylene	11	7	3.3	3
Benzo(k)fluoranthene	11	10	5.4	1.5
Benzoic acid	9	0	NA	8.6
bis(2-Chloroethoxy)methane	9	0	NA	3
bis(2-Chloroethyl)ether	9	0	NA	4.3
bis(2-Chloroisopropyl)ether	9	0	NA	3
bis(2-Ethylhexyl)phthalate	9	0	NA	3
Butyl benzyl phthalate	9	0	NA	3
Carbazole	9	2	1.5	4.3
Chrysene	11	11	7.6	NA
Dibenz(a,h)anthracene	11	4	0.80	3
Dibenzofuran	9	1	1.1	3
Diethylphthalate	9	0	NA	3
Dimethyl phthalate	9	0	NA	3
Di-N-Butyl Phthalate	9	0	NA	8.6
Di-N-Octyl Phthalate	9	0	NA	3
Fluoranthene	11	11	19	NA
Fluorene	11	6	2.2	3
Hexachlorobenzene	9	0	NA	3
Hexachlorocyclopentadiene	9	0	NA	3
Hexachloroethane	9	0	NA	3
Indeno(1,2,3-cd)pyrene	11	8	3.9	3
Isophorone	9	0	NA	3
Nitrobenzene	9	0	NA	3
N-Nitrosodimethylamine	9	0	NA	4.3
N-Nitroso-di-N-propylamine	9	0	NA	3
N-Nitrosodiphenylamine	9	0	NA	4.3
Pentachloronitrobenzene	9	0	NA	4.3
Pentachlorophenol	9	0	NA	4.3
Phenanthrene	11	10	19	1.5
Phenol	9	0	NA	3

Table 1. Summary statistics of chemistry data for sediment samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)
Pyrene	11	11	16	NA
Pyridine	9	0	NA	4.3
Naphthalene	11	2	0.77	3
Trichlorobenzene,1,2,4-	9	0	NA	3
Dichlorobenzene, 1,2- (o-DCB)	9	0	NA	3
Dichlorobenzene, 1,3-(m-DCB)	9	0	NA	3
Dichlorobenzene, 1,4- (p-DCB)	9	0	NA	3
Hexachlorobutadiene	9	0	NA	3
Naphthalene	9	0	NA	0.033
Tetrachloroethane, 1,1,1,2-	9	0	NA	0.033
Trichloroethane, 1,1,1-	9	0	NA	0.033
Tetrachloroethane, 1,1,2,2-	9	0	NA	0.02
Trichlorotrifluoroethane, 1,1,2-	9	0	NA	0.065
Trichloroethane, 1,1,2-	9	0	NA	0.033
Dichloroethane, 1,1-	9	0	NA	0.033
Dichloroethene, 1,1-	9	0	NA	0.033
Dichloropropene, 1,1-	9	0	NA	0.033
Trichlorobenzene, 1,2,3-	9	0	NA	0.033
Trichloropropane, 1,2,3-	9	0	NA	0.033
Trichlorobenzene,1,2,4-	9	0	NA	0.033
Trimethylbenzene, 1,2,4-	9	0	NA	0.033
Dibromo-3-chloropropane,1,2-	9	0	NA	0.033
Dichlorobenzene, 1,2- (o-DCB)	9	0	NA	0.033
Dichloroethane, 1,2-	9	0	NA	0.033
Dichloropropane, 1,2-	9	0	NA	0.033
Trimethylbenzene, 1,3,5-	9	0	NA	0.033
Dichlorobenzene, 1,3-(m-DCB)	9	0	NA	0.033
Dichloropropane, 1,3-	9	0	NA	0.033
Dichlorobenzene, 1,4- (p-DCB)	9	0	NA	0.033
Dichloropropane, 2,2-	9	0	NA	0.033
Chlorotoluene, 2-	9	0	NA	0.033
Methyl butyl ketone (2-Hexanone)	9	0	NA	0.16
Isopropyltoluene, 2- (o-Cymene)	9	0	NA	0.033
Chlorotoluene, 4-	9	0	NA	0.033
Isopropyltoluene, 4- (p-Cymene)	9	0	NA	0.033
Methyl Isobutyl Ketone (4-Methyl-2-penta	9	0	NA	0.16
Acetone	9	0	NA	1.6
Acrylonitrile	9	0	NA	0.033
Benzene	9	0	NA	0.033
Bromobenzene	9	0	NA	0.033
Bromochloromethane	9	0	NA	0.033
Bromodichloromethane	9	0	NA	0.033
Bromoform	9	0	NA	0.033
Bromomethane	9	0	NA	0.033
Butylbenzene, n-	9	0	NA	0.033
Butylbenzene, sec-	9	0	NA	0.033

Table 1. Summary statistics of chemistry data for sediment samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)
Butylbenzene, tert-	9	0	NA	0.033
Carbon disulfide	9	0	NA	0.033
Carbon tetrachloride	9	0	NA	0.033
Chlorobenzene	9	0	NA	0.033
Chloroethane	9	0	NA	0.033
Chloroform	9	0	NA	0.033
Chloromethane	9	0	NA	0.033
Dichloroethene, cis-1,2-	9	0	NA	0.033
Dichloropropene, cis-1,3-	9	0	NA	0.033
Dibromochloromethane	9	0	NA	0.02
Dibromomethane	9	0	NA	0.033
Dichlorodifluoromethane	9	0	NA	0.033
Ethylbenzene	9	0	NA	0.033
Ethylene Dibromide (EDB)	9	0	NA	0.033
Hexachlorobutadiene	9	0	NA	0.033
Isopropylbenzene (cumene)	9	0	NA	0.033
Xylene, m,p-	9	0	NA	0.033
Methyl ethyl ketone	9	0	NA	0.2
Methyl Tert-Butyl Ether (MTBE)	9	0	NA	0.065
Methylene Chloride (Dichloromethane)	9	0	NA	0.065
Propylbenzene, n-	9	0	NA	0.033
Xylene, o-	9	0	NA	0.033
Styrene	9	0	NA	0.033
Tetrachloroethylene (PCE)	9	0	NA	0.033
Tetrahydrofuran	9	0	NA	0.065
Toluene	9	1	0.24	0.0065
Dichloroethene, trans-1,2-	9	0	NA	0.033
Dichloropropene, trans-1,3-	9	0	NA	0.033
Dichloro-2-butene, trans-1,4-	9	0	NA	0.065
Trichloroethylene (TCE)	9	0	NA	0.033
Trichlorofluoromethane	9	0	NA	0.033
Vinyl Chloride	9	0	NA	0.033
Xylene (Total)	9	0	NA	0.033

Notes:

Conc. - concentration

mg/kg - milligram per killogram

NA - not available

Table 2. Summary statistics of chemistry data for surface water samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
CT ETPH	4	0	NA	70
Antimony (Total)	4	0	NA	5
Antimony (Dissolved)	4	0	NA	5
Arsenic (Total)	4	0	NA	4
Arsenic (Dissolved)	4	0	NA	4
Barium (Total)	4	4	53	NA
Barium (Dissolved)	4	4	56	NA
Beryllium (Total)	4	0	NA	1
Beryllium (Dissolved)	4	0	NA	1
Cadmium (Total)	4	0	NA	1
Cadmium (Dissolved	4	0	NA	1
Chromium (Total)	4	0	NA	1
Chromium (Dissolved)	4	2	1	1
Copper (Total)	4	0	NA	5
Copper (Dissolved)	4	0	NA	5
Lead (Total)	4	0	NA	2
Lead (Dissolved)	4	0	NA	2
Mercury (Total)	4	0	NA	0.2
Mercury (Dissolved)	4	0	NA	0.2
Nickel (Total)	4	0	NA	1
Nickel (Dissolved)	4	0	NA	1
Selenium (Total)	4	0	NA	10
Selenium (Dissolved)	4	0	NA	11
Silver (Total)	4	0	NA	1
Silver (Dissolved)	4	0	NA	1
Thallium (Total)	4	0	NA	1
Thallium (Dissolved)	4	0	NA	2
Vanadium (Total)	4	0	NA	2
Vanadium (Dissolved)	4	0	NA	2
Zinc (Total)	4	1	2.5	2
Zinc (Dissolved)	4	4	6	NA
Cyanide (Total)	4	0	NA	10
Tetrachlorobenzene, 1,2,4,5-	4	0	NA	0.49
Diphenylhydrazine, 1,2-	4	0	NA	4.9
Trichlorophenol, 2,4,5-	4	0	NA	0.99
Trichlorophenol, 2,4,6-	4	0	NA	0.99
Dichlorophenol, 2,4-	4	0	NA	0.99
Dimethylphenol, 2,4-	4	0	NA	0.99
Dinitrophenol, 2,4-	4	0	NA	0.99
Dinitrotoluene, 2,4-	4	0	NA	4.9
Dinitrotoluene, 2,6-	4	0	NA	4.9
Chloronaphthalene, 2-	4	0	NA	4.9
Chlorophenol, 2-	4	0	NA	0.99
Methylnaphthalene, 2-	4	0	NA	0.99
Methylphenol, 2-	4	0	NA	0.99
Nitroaniline, 2-	4	0	NA	4.9
Nitrophenol, 2-	4	0	NA	0.99

Table 2. Summary statistics of chemistry data for surface water samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
Methylphenol, 3&4 (Cresol, m&p-)	4	0	NA	9.9
Dichlorobenzidine, 3,3-	4	0	NA	4.9
Nitroaniline, 3-	4	0	NA	4.9
Dinitro-2-methylphenol, 4,6-	4	0	NA	0.99
Bromophenyl Phenyl Ether, 4-	4	0	NA	4.9
Chloro-3-methylphenol, 4-	4	0	NA	0.99
Chloroanilne, p- (4-Chloroaniline)	4	0	NA	4.9
Chlorophenyl-phenylether, 4-	4	0	NA	0.99
Nitroaniline, 4-	4	0	NA	4.9
Nitrophenol, 4-	4	0	NA	0.99
Acenaphthene	4	0	NA	0.05
Acenaphthylene	4	0	NA	0.05
Acetophenone	4	0	NA	4.9
Aniline	4	0	NA	4.9
Anthracene	4	0	NA	0.05
Benzo(a)anthracene	4	0	NA	0.05
Benzidine	4	0	NA	4.9
Benzo(a)pyrene	4	0	NA	0.05
Benzo(b)fluoranthene	4	0	NA	0.05
Benzo(g,h,i)perylene	4	0	NA	0.2
Benzo(k)fluoranthene	4	0	NA	0.05
Benzoic acid	4	0	NA	49
bis(2-Chloroethoxy)methane	4	0	NA	4.9
bis(2-Chloroethyl)ether	4	0	NA	0.99
bis(2-Chloroisopropyl)ether	4	0	NA	4.9
bis(2-Ethylhexyl)phthalate	4	0	NA	0.49
Butyl benzyl phthalate	4	0	NA	4.9
Carbazole	4	0	NA	4.9
Chrysene	4	0	NA	0.05
Dibenz(a,h)anthracene	4	0	NA	0.01
Dibenzofuran	4	0	NA	0.05
Diethylphthalate	4	0	NA	4.9
Dimethyl phthalate	4	0	NA	4.9
Di-N-Butyl Phthalate	4	0	NA	4.9
Di-N-Octyl Phthalate	4	0	NA	4.9
Fluoranthene	4	0	NA	0.05
Fluorene	4	0	NA	0.1
Hexachlorobenzene	4	0	NA	0.05
Hexachlorocyclopentadiene	4	0	NA	0.05
Hexachloroethane	4	0	NA	0.49
Indeno(1,2,3-cd)pyrene	4	0	NA	0.05
Isophorone	4	0	NA	4.9
Nitrobenzene	4	0	NA	0.1
N-Nitrosodimethylamine	4	0	NA	4.9
N-Nitroso-di-N-propylamine	4	0	NA	4.9
N-Nitrosodiphenylamine	4	0	NA	4.9
Pentachloronitrobenzene	4	0	NA	0.10

Table 2. Summary statistics of chemistry data for surface water samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
Pentachlorophenol	4	0	NA	0.79
Phenanthrene	4	0	NA	0.05
Phenol	4	0	NA	0.99
Pyrene	4	0	NA	0.05
Pyridine	4	0	NA	0.49
Naphthalene	4	0	NA	0.10
Tetrachloroethane, 1,1,1,2-	4	0	NA	1.0
Trichloroethane, 1,1,1-	4	0	NA	1.0
Tetrachloroethane, 1,1,2,2-	4	0	NA	0.5
Trichlorotrifluoroethane, 1,1,2-	4	0	NA	1.0
Trichloroethane, 1,1,2-	4	0	NA	1.0
Dichloroethane, 1,1-	4	0	NA	1.0
Dichloroethene, 1,1-	4	0	NA	1.0
Dichloropropene, 1,1-	4	0	NA	1.0
Trichlorobenzene, 1,2,3-	4	0	NA	1.0
Trichloropropane, 1,2,3-	4	0	NA	1.0
Trichlorobenzene,1,2,4-	4	0	NA	4.7
Trimethylbenzene, 1,2,4-	4	0	NA	1.0
Dibromo-3-chloropropane,1,2-	4	0	NA	1.0
Dichlorobenzene, 1,2- (o-DCB)	4	0	NA	2.5
Dichloroethane, 1,2-	4	0	NA	0.6
Dichloropropane, 1,2-	4	0	NA	1.0
Trimethylbenzene, 1,3,5-	4	0	NA	1.0
Dichlorobenzene, 1,3-(m-DCB)	4	0	NA	2.5
Dichloropropane, 1,3-	4	0	NA	1.0
Dichlorobenzene, 1,4- (p-DCB)	4	0	NA	2.5
Dichloropropane, 2,2-	4	0	NA	1.0
Chlorotoluene, 2-	4	0	NA	1.0
Methyl butyl ketone (2-Hexanone)	4	0	NA	5.0
Isopropyltoluene, 2- (o-Cymene)	4	0	NA	1.0
Chlorotoluene, 4-	4	0	NA	1.0
Isopropyltoluene, 4- (p-Cymene)	4	0	NA	1.0
Methyl Isobutyl Ketone (4-Methyl-2-penta	4	0	NA	5.0
Acetone	4	0	NA	25
Acrylonitrile	4	0	NA	5.0

Table 2. Summary statistics of chemistry data for surface water samples in the Hockanum River at the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
Benzene	4	0	NA	0.7
Bromobenzene	4	0	NA	1.0
Bromochloromethane	4	0	NA	1.0
Bromodichloromethane	4	0	NA	0.5
Bromoform	4	0	NA	1.0
Bromomethane	4	0	NA	1.0
Butylbenzene, n-	4	0	NA	1.0
Butylbenzene, sec-	4	0	NA	1.0
Butylbenzene, tert-	4	0	NA	1.0
Carbon disulfide	4	0	NA	5.0
Carbon tetrachloride	4	0	NA	1.0
Chlorobenzene	4	0	NA	1.0
Chloroethane	4	0	NA	1.0
Chloroform	4	0	NA	1.0
Chloromethane	4	0	NA	1.0
Dichloroethene, cis-1,2-	4	0	NA	1.0
Dichloropropene, cis-1,3-	4	0	NA	0.4
Dibromochloromethane	4	0	NA	0.5
Dibromomethane	4	0	NA	1.0
Dichlorodifluoromethane	4	0	NA	1.0
Ethylbenzene	4	0	NA	1.0
Ethylene Dibromide (EDB)	4	0	NA	1.0
Hexachlorobutadiene	4	0	NA	0.49
Isopropylbenzene (cumene)	4	0	NA	1.0
Xylene, m,p-	4	0	NA	1.0
Methyl ethyl ketone	4	0	NA	5.0
Methyl Tert-Butyl Ether (MTBE)	4	0	NA	1.0
Methylene Chloride (Dichloromethane)	4	0	NA	1.0
Propylbenzene, n-	4	0	NA	1.0
Xylene, o-	4	0	NA	1.0
Styrene	4	0	NA	1.0
Tetrachloroethylene (PCE)	4	0	NA	1.0
Tetrahydrofuran	4	0	NA	2.5
Toluene	4	0	NA	1.0
Dichloroethene, trans-1,2-	4	0	NA	1.0
Dichloropropene, trans-1,3-	4	0	NA	0.4
Dichloro-2-butene, trans-1,4-	4	0	NA	5.0
Trichloroethylene (TCE)	4	0	NA	1.0
Trichlorofluoromethane	4	0	NA	1.0
Vinyl Chloride	4	0	NA	1.0
Xylene (Total)	4	0	NA	1.0

Notes:

Conc. - concentration

ug/L - microgram per liter

NA - not available

Table 3. Ecological screening levels selected for freshwater sediments

Analyte	Sediment Screening Level (mg/kg)	Source, Value
CT ETPH	NR	
Antimony	0.16	Buchman 2008, bkg
Arsenic	9.79	Buchman 2008, TEC
Barium	0.7	Buchman 2008, bkg
Beryllium	NR	
Cadmium	0.99	Buchman 2008, TEC
Chromium (Total)	43.4	Buchman 2008, TEC
Copper	31.6	Buchman 2008, TEC
Lead	35.8	Buchman 2008, TEC
Mercury	0.18	Buchman 2008, TEC
Nickel	22.7	Buchman 2008, TEC
Selenium	2	BTAG RIII 2006, SLV
Silver	1	BTAG RIII 2006, SLV
Thallium	NR	
Vanadium	50	Buchman 2008, bkg
Zinc	121	Buchman 2008, TEC
Cyanide (Total)	0.1	BTAG RIII 2006, SLV
Aroclor-1016	NR	
Aroclor-1221	NR	
Aroclor-1232	NR	
Aroclor-1242	NR	
Aroclor-1248	NR	
Aroclor-1254	0.06	Buchman 2008, TEL
Aroclor-1260	NR	
Aroclor-1262	NR	
Aroclor-1268	NR	
PCBs (Total)	0.0598	Buchman 2008, TEC
Tetrachlorobenzene, 1,2,4,5-	1.09	BTAG RIII 2006, SLV
Diphenylhydrazine, 1,2-	NR	
Trichlorophenol, 2,4,5-	NR	
Trichlorophenol, 2,4,6-	0.213	BTAG RIII 2006, SLV
Dichlorophenol, 2,4-	0.117	BTAG RIII 2006, SLV
Dimethylphenol, 2,4-	0.029	BTAG RIII 2006, SLV
Dinitrophenol, 2,4-	0.00621	EPA 2003, R5 ESL
Dinitrotoluene, 2,4-	0.0416	BTAG RIII 2006, SLV
Dinitrotoluene, 2,6-	0.0398	EPA 2003, R5 ESL
Chloronaphthalene, 2-	0.417	EPA 2003, R5 ESL
Chlorophenol, 2-	0.0312	BTAG RIII 2006, SLV
Methylnaphthalene, 2-	0.0202	BTAG RIII 2006, SLV
Methylphenol, 2-	0.0554	EPA 2003, R5 ESL
Nitroaniline, 2-	NR	
Nitrophenol, 2-	NR	
Methylphenol, 3&4 (Cresol, m&p-)	0.67	BTAG RIII 2006, SLV
Dichlorobenzidine, 3,3-	0.127	BTAG RIII 2006, SLV
Nitroaniline, 3-	NR	
Dinitro-2-methylphenol, 4,6-	0.104	EPA 2003, R5 ESL

Table 3. Ecological screening levels selected for freshwater sediments

Analyte	Sediment Screening Level (mg/kg)	Source, Value
Bromophenyl Phenyl Ether, 4-	1.23	BTAG RIII 2006, SLV
Chloro-3-methylphenol, 4-	0.388	EPA 2003, R5 ESL
Chloroanilne, p- (4-Chloroaniline)	0.146	EPA 2003, R5 ESL
Chlorophenyl-phenylether, 4-	NR	
Nitroaniline, 4-	NR	
Nitrophenol, 4-	0.0133	EPA 2003, R5 ESL
Acenaphthene	0.0067	BTAG RIII 2006, SLV
Acenaphthylene	0.0059	BTAG RIII 2006, SLV
Acetophenone	NR	
Aniline	0.00031	EPA 2003, R5 ESL
Anthracene	0.0572	Buchman 2008, TEC
Benzo(a)anthracene	0.108	Buchman 2008, TEC
Benzidine	NR	
Benzo(a)pyrene	0.15	Buchman 2008, TEC
Benzo(b)fluoranthene	10.4	EPA 2003, R5 ESL
Benzo(g,h,i)perylene	0.17	BTAG RIII 2006, SLV
Benzo(k)fluoranthene	0.0272	Buchman 2008, TEL-H
Benzoic acid	0.65	BTAG RIII 2006, SLV
bis(2-Chloroethoxy)methane	NR	
bis(2-Chloroethyl)ether	3.52	EPA 2003, R5 ESL
bis(2-Chloroisopropyl)ether	NR	
bis(2-Ethylhexyl)phthalate	0.18	BTAG RIII 2006, SLV
Butyl benzyl phthalate	11	EPA 1996, ET
Carbazole	NR	
Chrysene	0.166	Buchman 2008, TEC
Dibenz(a,h)anthracene	0.033	Buchman 2008, TEC
Dibenzofuran	2	EPA 1996, ET
Diethylphthalate	0.63	EPA 1996, ET
Dimethyl phthalate	NR	
Di-N-Butyl Phthalate	11	EPA 1996, ET
Di-N-Octyl Phthalate	40.6	EPA 2003, R5 ESL
Fluoranthene	0.423	Buchman 2008, TEC
Fluorene	0.0774	Buchman 2008, TEC
Hexachlorobenzene	0.02	BTAG RIII 2006, SLV
Hexachlorocyclopentadiene	0.901	EPA 2003, R5 ESL
Hexachloroethane	1.0	EPA 1996, ET
Indeno(1,2,3-cd)pyrene	0.0173	Buchman 2008, TEL-H
Isophorone	0.432	EPA 2003, R5 ESL
Nitrobenzene	0.145	EPA 2003, R5 ESL
N-Nitrosodimethylamine	NR	
N-Nitroso-di-N-propylamine	NR	
N-Nitrosodiphenylamine	2.68	BTAG RIII 2006, SLV
Pentachloronitrobenzene	NR	
Pentachlorophenol	0.504	BTAG RIII 2006, SLV
Phenanthrene	0.204	Buchman 2008, TEC
Phenol	0.42	BTAG RIII 2006, SLV

Table 3. Ecological screening levels selected for freshwater sediments

Analyte	Sediment Screening Level (mg/kg)	Source, Value
Pyrene	0.195	Buchman 2008, TEC
Pyridine	0.106	EPA 2003, R5 ESL
Naphthalene	0.176	Buchman 2008, TEC
Trichlorobenzene,1,2,4-	9.2	EPA 1996, ET
Dichlorobenzene, 1,2- (o-DCB)	0.34	EPA 1996, ET
Dichlorobenzene, 1,3-(m-DCB)	1.7	EPA 1996, ET
Dichlorobenzene, 1,4- (p-DCB)	0.35	EPA 1996, ET
Hexachlorobutadiene	0.0265	EPA 2003, R5 ESL
Naphthalene	0.176	Buchman 2008, TEC
Tetrachloroethane, 1,1,1,2-	NR	
Trichloroethane, 1,1,1-	0.17	EPA 1996, ET
Tetrachloroethane, 1,1,2,2-	0.94	EPA 1996, ET
Trichlorotrifluoroethane, 1,1,2-	NR	
Trichloroethane, 1,1,2-	1.24	BTAG RIII 2006, SLV
Dichloroethane, 1,1-	0.000575	EPA 2003, R5 ESL
Dichloroethene, 1,1-	0.031	BTAG RIII 2006, SLV
Dichloropropene, 1,1-	NR	
Trichlorobenzene, 1,2,3-	0.858	BTAG RIII 2006, SLV
Trichloropropane, 1,2,3-	NR	
Trichlorobenzene,1,2,4-	9.2	EPA 1996, ET
Trimethylbenzene, 1,2,4-	NR	
Dibromo-3-chloropropane,1,2-	NR	
Dichlorobenzene, 1,2- (o-DCB)	0.34	EPA 1996, ET
Dichloroethane, 1,2-	0.26	EPA 2003, R5 ESL
Dichloropropane, 1,2-	0.333	EPA 2003, R5 ESL
Trimethylbenzene, 1,3,5-	NR	
Dichlorobenzene, 1,3-(m-DCB)	1.7	EPA 1996, ET
Dichloropropane, 1,3-	NR	
Dichlorobenzene, 1,4- (p-DCB)	0.35	EPA 1996, ET
Dichloropropane, 2,2-	NR	
Chlorotoluene, 2-	NR	
Methyl butyl ketone (2-Hexanone)	NR	
Isopropyltoluene, 2- (o-Cymene)	NR	
Chlorotoluene, 4-	NR	
Isopropyltoluene, 4- (p-Cymene)	NR	
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	NR	
Acetone	0.0099	EPA 2003, R5 ESL
Acrylonitrile	0.0012	EPA 2003, R5 ESL
Benzene	0.142	EPA 2003, R5 ESL
Bromobenzene	NR	
Bromochloromethane	NR	
Bromodichloromethane	NR	
Bromoform	0.654	BTAG RIII 2006, SLV
Bromomethane	0.00137	EPA 2003, R5 ESL
Butylbenzene, n-	NR	
Butylbenzene, sec-	NR	

Table 3. Ecological screening levels selected for freshwater sediments

Analyte	Sediment Screening Level (mg/kg)	Source, Value
Butylbenzene, tert-	NR	
Carbon disulfide	0.000851	BTAG RIII 2006, SLV
Carbon tetrachloride	0.0642	BTAG RIII 2006, SLV
Chlorobenzene	0.82	EPA 1996, ET
Chloroethane	NR	
Chloroform	0.121	EPA 2003, R5 ESL
Chloromethane	NR	
Dichloroethene, cis-1,2-	NR	
Dichloropropene, cis-1,3-	0.0000509	BTAG RIII 2006, SLV
Dibromochloromethane	NR	
Dibromomethane	NR	
Dichlorodifluoromethane	NR	
Ethylbenzene	3.6	EPA 1996, ET
Ethylene Dibromide (EDB)	NR	
Hexachlorobutadiene	0.0265	EPA 2003, R5 ESL
Isopropylbenzene (cumene)	0.086	BTAG RIII 2006, SLV
Xylene, m,p-	0.0252	BTAG RIII 2006, SLV
Methyl ethyl ketone	0.0424	EPA 2003, R5 ESL
Methyl Tert-Butyl Ether (MTBE)	NR	
Methylene Chloride (Dichloromethane)	0.159	EPA 2003, R5 ESL
Propylbenzene, n-	NR	
Xylene, o-	NR	
Styrene	0.559	BTAG RIII 2006, SLV
Tetrachloroethylene (PCE)	0.53	EPA 1996, ET
Tetrahydrofuran	NR	
Toluene	0.67	EPA 1996, ET
Dichloroethene, trans-1,2-	1.05	BTAG RIII 2006, SLV
Dichloropropene, trans-1,3-	0.0000509	BTAG RIII 2006, SLV
Dichloro-2-butene, trans-1,4-	NR	
Trichloroethylene (TCE)	1.6	EPA 1996, ET
Trichlorofluoromethane	NR	
Vinyl Chloride	0.202	EPA 2003, R5 ESL
Xylene (Total)	0.433	EPA 2003, R5 ESL

Notes:

bkg - background

ESL - ecological screening level

ET - ecotox threshold

NR - not reported

SLV - screening level value

TEC - threshold effect concentration

TEL - threshold effect level

TEL-H - ARCS threshold level (*Hyalella azteca*)

Table 4. Summary of chemicals of potential ecological concern for sediment

Chemical	Class	BCC (Y/N)	MDC > SL (Y/N)	Other Reason for CoPEC Selection
Detected CoPECs				
CT EPH	Hydrocarbon	B	N	No SL, but is a BCC
Arsenic	Metal	B	N	Is a BCC
Barium	Metal		Y	
Cadmium	Metal		Y	
Chromium (Total)	Metal		Y	
Copper	Metal		Y	
Lead	Metal		Y	
Mercury	Metal		Y	
Nickel	Metal		Y	
Vanadium	Metal		Y	
Zinc	Metal		Y	
Methylnaphthalene, 2-	PAH		Y	
Acenaphthene	PAH		Y	
Acenaphthylene	PAH		Y	
Anthracene	PAH		Y	
Benzo(a)anthracene	PAH		Y	
Benzo(a)pyrene	PAH		Y	
Benzo(b)fluoranthene	PAH	B	N	Is a BCC
Benzo(g,h,i)perylene	PAH		Y	
Benzo(k)fluoranthene	PAH		Y	
Chrysene	PAH		Y	
Dibenz(a,h)anthracene	PAH		Y	
Fluoranthene	PAH		Y	
Fluorene	PAH		Y	
Indeno(1,2,3-cd)pyrene	PAH		Y	
Phenanthrene	PAH		Y	
Pyrene	PAH		Y	
Naphthalene	PAH		Y	

Non-Detected CoPECS (MRL > SL)	
Metals	3 (Antimony, Selenium, Silver)
Inorganic	1 (Cyanide)
SVOCs	35 (Tetrachlorobenzene, 1,2,4,5-; Trichlorophenol, 2,4,6-; Dichlorophenol, 2,4-; Dimethylphenol, 2,4-; Dinitrophenol, 2,4-; Dinitrotoluene, 2,4-; Dinitrotoluene, 2,6-; Chloronaphthalene, 2-; Chlorophenol, 2-; Methylphenol, 2-; Methylphenol, 3&4 (Cresol, m&p-); Dichlorobenzidine, 3,3-; Dinitro-2-methylphenol, 4,6-; Bromophenyl Phenyl Ether, 4-; Chloro-3-methylphenol, 4-; Chloroanilne, p- (4-Chloroaniline); Nitrophenol, 4-; Aniline; Benzoic acid; bis(2-Chloroethyl)ether; bis(2-Ethylhexyl)phthalate; Diethylphthalate; Hexachlorobenzene; Hexachlorocyclopentadiene; Hexachloroethane; Isophorone; Nitrobenzene; N-Nitrosodiphenylamine; Pentachlorophenol; Phenol; Pyridine; Dichlorobenzene, 1,2- (o-DCB); Dichlorobenzene, 1,3-(m-DCB); Dichlorobenzene, 1,4- (p-DCB); Hexachlorobutadiene)
VOCs	11 (Dichloroethane, 1,1-; Dichloroethene, 1,1-; Acetone; Acrylonitrile; Bromobenzene; Carbon disulfide; Dichloropropene, cis-1,3-; Hexachlorobutadiene; Xylene, m,p-; Methyl ethyl ketone; Dichloropropene, trans-1,3-)

Notes:
Refer to Appendix A for the complete summary of CoPECs.
CoPEC are based on exceedance of the freshwater sediment screening level.
Detected CoPEC are evaluated quantitatively; non-detected CoPEC evaluated in the uncertatiny analysis.
MDC - maximum detected concentration
MRL - maximum reporting limit
SL - screening level
BCC - bioaccumulative chemical compound
PAHs - polycyclic aromatic hydrocarbons
VOCs - volatile organic compound
SVOCs - semivolatile organic compound

Table 5. Ecological screening levels selected for freshwater

Analyte	Surface Water Screening Level (ug/L)	Source, Value
CT ETPH	NR	
Arsenic	150	CTDEEP 2011, CWQS
Arsenic	150	CTDEEP 2011, CWQS
Cadmium	0.125	CTDEEP 2011, CWQS*
Cadmium	0.125	CTDEEP 2011, CWQS*
Chromium (Total)	11	CTDEEP 2011, CWQS
Chromium (Total)	11	CTDEEP 2011, CWQS
Copper	4.8	CTDEEP 2011, CWQS*
Copper	4.8	CTDEEP 2011, CWQS*
Lead	1.2	CTDEEP 2011, CWQS*
Lead	1.2	CTDEEP 2011, CWQS*
Mercury	0.77	CTDEEP 2011, CWQS
Mercury	0.77	CTDEEP 2011, CWQS
Nickel	28.9	CTDEEP 2011, CWQS*
Nickel	28.9	CTDEEP 2011, CWQS*
Selenium	5	CTDEEP 2011, CWQS
Selenium	5	CTDEEP 2011, CWQS
Zinc	65	CTDEEP 2011, CWQS*
Zinc	65	CTDEEP 2011, CWQS*
Cyanide (Total)	5.2	CTDEEP 2011, CWQS
Pentachlorophenol	15	CTDEEP 2011, CWQS

Notes:

AWQC - ambient water quality criteria

CCC - criteria chronic concentration

CMC - criteria maximum concentration

CTDEEP - Connecticut Department of Energy and Environmental Protection

CWQS - Connecticut water quality standard

ESL - ecological screening level

ET - ecotox threshold

FCV - final chronic value

NR - not reported

SCV - secondary chronic value

SLV - screening level value

* - The criterion for this metal is hardness-dependent; data are screened with values in this source.

Table 6. Summary of chemicals of potential ecological concern for surface water

Chemical	Class	BCC	MDC > SL (Y/N)	Other Reason for CoPEC Selection
Detected CoPECs				
Barium (Total)	Metal		Y	
Barium (Dissolved)	Metal		Y	
Zinc (Total)	Metal	B	N	Is a BCC
Zinc (Dissolved)	Metal	B	N	Is a BCC
Non-Detected CoPECS (MRL > SL)				
Metals	6 (Beryllium; Cadmium; Copper; Lead; Selenium; Silver)[1]			
Inorganics	1 (Cyanide)			
PAHs	3 (Benzo(a)anthracene; Benzo(a)pyrene; Pyrene)			
SVOCs	9 (Chloronaphthalene, 2-; Dichlorobenzidine, 3,3-; Bromophenyl Phenyl Ether, 4-; Chloro-3-methylphenol, 4-; Aniline; Benzidine; Benzoic acid; Dimethyl phthalate; Hexachlorobenzene)			
VOCs	3 (Carbon disulfide; Dichloropropene, cis-1,3-; Dichloropropene, trans-1,3-)			

Notes:

Refer to Appendix A for the complete summary of CoPECs.

CoPEC are based on exceedance of the surface water screening level.

Detected CoPEC are evaluated quantitatively; non-detected CoPEC evaluated in the uncertatiny analysis.

MDC - maximum detected concentration

MRL - maximum reporting limit

SL - screening level

BCC - bioaccumulative chemical compound

PAHs - polycyclic aromatic hydrocarbons

VOCs - volatile organic compounds

SVOCs - semivolatile organic compounds

[1]Metals category of Non-Detected CoPECs refer to both the total and dissolved forms of the metals listed.

Table 7. Combined list of chemicals of potential ecological concern

Chemical	CoPEC	Comment
CT ETPH	X	This will be evaluated through individual compounds in PAH list.
Arsenic	X	
Barium	X	
Cadmium	X	
Chromium (Total)	X	
Copper	X	
Lead	X	
Mercury	X	
Nickel	X	
Vanadium	X	
Zinc	X	
Methylnaphthalene, 2-	X	
Acenaphthene	X	
Acenaphthylene	X	
Anthracene	X	
Benzo(a)anthracene	X	
Benzo(a)pyrene	X	
Benzo(b)fluoranthene	X	
Benzo(g,h,i)perylene	X	
Benzo(k)fluoranthene	X	
Chrysene	X	
Dibenz(a,h)anthracene	X	
Fluoranthene	X	
Fluorene	X	
Indeno(1,2,3-cd)pyrene	X	
Phenanthrene	X	
Pyrene	X	
Naphthalene	X	

Note:

Total polycyclic aromatic hydrocarbons (PAHs) will also be evaluated as a CoPEC because several TRVs are available as the sum of individual PAHs (or Total PAHs).

Table 8. Exposure profiles for wildlife receptors

	Mallard *Anas platyrhynchos* Avian herbivore		Great Blue Heron *Ardea herodias* Avian Omnivore		Raccoon *Procyon lotor* Mammalian Omnivore	
	Value	Source	Value	Source	Value	Source
Body Weight (BW) (kilograms)	1.043	Nelson and Martin (1983, as cited by U.S. EPA 1993)	2.2	Hartman (1961 as cited in U.S. EPA 1993)	6.0	Sanderson (1984, as cited by U.S. EPA 1993)
BW-normalized Food Ingestion Rate ($NFIR_{dry}$) (kg/kg bw-day, dry wt.)	0.050	Estimated from Nagy (2001) for omnnivorous birds	0.038	Estimated from Nagy (2001) for omnnivorous birds	0.026	Estimated from Nagy (2001) for omnivorous mammals
BW-normalized Food Ingestion Rate ($NFIR_{wet}$) (kg/kg bw-day, wet wt.)	0.16	Estimated from Nagy (2001) for omnnivorous birds	0.12	Estimated from Nagy (2001) for omnnivorous birds	0.082	Estimated from Nagy (2001) for omnivorous mammals
Fraction Soil/Sediment of Diet (FSD)	0.033	Beyer et al. (1994)	0.014	Estimated from Pascoe et al. 1996	0.094	Beyer et al. (1994)
Normalized Soil/Sediment Ingestion Rate (NSIR) (kg/kg bw-day, dry wt.)	0.0017	Calculated (product of $NFIR_{dry}$ and FSD)	0.00053	Calculated (product of $NFIR_{dry}$ and FSD)	0.0025	Calculated (product of $NFIR_{dry}$ and FSD)
BW-normalized Water Ingestion Rate (NWIR) (L/kg bw-day)	0.058	Estimated from Calder and Braun (1983)	0.045	Estimated from Calder and Braun (1983)	0.083	Estimated from Calder and Braun (1983)
Dietary Components	Grass, rice, snails, insects, annelids, crustaceans	U.S.EPA (1993)	Mostly fish, aquatic invertebrates, some small mammals	U.S.EPA (1993)	Aquatic invertebrates, some fish, insects, earthworms, vegetation	U.S.EPA (1993)
Assumed Diets for Food Chain Models	100% Plants		50% Fish; 50% Benthic Invertebrates		50% Fish; 50% Benthic Invertebrates	
Foraging Range (FR) (units vary)	1,334 acres	Kirby et al. (1985, as cited in U.S. EPA 1993)	3.1 km shoreline	Dowd and Flake (1985, as cited by U.S. EPA 1993)	267 acres	Stuewer (1943, as cited in U.S. EPA 1993)

Table 9. Exposure point concentrations for sediment and surface water

	Sediment		Surface Water	
CoPEC	Value Used (mg/kg)	Basis	Value Used (mg/L)	Basis
Arsenic	7.3	MDC	0.004	MRL
Barium	324	MDC	0.056	MDC
Cadmium	2.9	MDC	0.001	MRL
Chromium (Total)	66.4	MDC	0.001	MRL
Copper	2190	MDC	0.005	MRL
Lead	267	MDC	0.002	MRL
Mercury	0.21	MDC	0.0002	MRL
Nickel	41.6	MDC	0.001	MRL
Vanadium	109	MDC	0.002	MRL
Zinc	606	MDC	0.006	MDC
Methylnaphthalene, 2-	0.79	MDC	0.00099	MRL
Acenaphthene	1.3	MDC	0.00005	MRL
Acenaphthylene	1.4	MDC	0.00005	MRL
Anthracene	3.3	MDC	0.00005	MRL
Benzo(a)anthracene	7.2	MDC	0.00005	MRL
Benzo(a)pyrene	6.1	MDC	0.00005	MRL
Benzo(b)fluoranthene	5.3	MDC	0.00005	MRL
Benzo(g,h,i)perylene	3.3	MDC	0.0002	MRL
Benzo(k)fluoranthene	5.4	MDC	0.00005	MRL
Chrysene	7.6	MDC	0.00005	MRL
Dibenz(a,h)anthracene	0.80	MDC	0.00001	MRL
Fluoranthene	19	MDC	0.00005	MRL
Fluorene	2.2	MDC	0.0001	MRL
Indeno(1,2,3-cd)pyrene	3.9	MDC	0.00005	MRL
Naphthalene	0.77	MDC	0.0001	MRL
Phenanthrene	19	MDC	0.00005	MRL
Pyrene	16	MDC	0.00005	MRL
Total PAHs	100	MDC	0.002	MRL

Notes:

CoPEC - contaminant of potential ecological concern

MDC - maximum detected concentration

MRL - maximum reporting limit

For metal EPCs in surface water the maximum value between the dissolved and total measurement was used.

PAHs - polycyclic aromatic hydrocarbons

Table 10. Exposure point concentrations for plants, invertebrates, and fishes

	Plant EPC Calculation			Invertebrate EPC Calculation				Fish EPC Calculation		
CoPEC	Sediment-Plant BAF	Max. Sediment Conc. EPC (mg/kg)	Estimated Plant Conc. (mg/kg ww)	Sediment-Invertebrate BAF		Max. Sediment Conc. EPC (mg/kg)	Estimated Invertebrate Conc. (mg/kg ww)	Trophic Transfer Factor	Estimated Invertebrate Conc. (mg/kg ww)	Estimated Fish Conc. (mg/kg ww)
Arsenic	=(0.2*0.03752*Sed Conc.)	7.3	0.055	=(0.3*(10^(0.754*log(Sed Conc.)-0.292)))		7.3	0.69	2.2	0.69	1.51
Barium	=(0.2*0.156*Sed Conc.)	324	10.1	=(0.3*0.091*Sed Conc.)		324	8.85	1 [a]	8.85	8.85
Cadmium	=(0.2*(EXP(0.546*LN(Sed Conc.)-0.475)))	2.9	0.22	=(0.3*(10^(0.692*log(Sed Conc.)+0.0395)))		2.9	0.69	5.0	0.69	3.43
Chromium	=(0.2*0.041*Sed Conc.)	66.4	0.54	=(0.3*(10^(0.365*log(Sed Conc.)+0.2092)))		66.4	2.25	0.10	2.25	0.22
Copper	=(0.2*(EXP(0.394*LN(Sed Conc.)+0.668)))	2190	8.08	=(0.3*(10^(0.278*log(Sed Conc.)+0.1.089)))		2190	31.2	0.5	31.2	15.6
Lead	=(0.2*(EXP(0.561*LN(Sed Conc.)-1.328)))	267	1.22	=(0.3*(10^(0.801*log(Sed Conc.)-0.776)))		267	4.41	0.3	4.41	1.32
Mercury	=(0.2*(EXP(0.544*LN(Sed Conc.)-0.996)))	0.21	0.032	=(0.3*(10^(0.327*log(Sed Conc.)-0.67)))		0.21	0.039	8	0.039	0.31
Nickel	=(0.2*(EXP(0.748*LN(Sed Conc.)-2.223)))	41.6	0.35	=(0.3*(10^(-0.425*log(Sed Conc.)+1.48)))		41.6	1.86	1.5	1.86	2.79
Vanadium	=(0.2*0.00485*Sed Conc.)	109	0.11	=(0.3*0.042*Sed Conc.)		109	1.37	0.4	1.37	0.55
Zinc	=(0.2*(EXP(0.554*LN(Sed Conc.)+1.575)))	606	33.6	=(0.3*(10^(0.208*log(Sed Conc.)+1.8)))		606	71.8	1.0	71.8	71.8
2-Methylnaphthalene	=(0.2*12.2*Sed Conc.)	0.79	1.9		--	0.79		--		
Acenaphthene	=(0.2*(EXP(-0.8556*LN(Sed Conc.)-5.562)))	1.3	0.0006		--	1.3		--		
Acenaphthylene	=(0.2*(EXP(0.791*LN(Sed Conc.)-1.144)))	1.4	0.08		--	1.4		--		
Anthracene	=(0.2*(EXP(0.7784*LN(Sed Conc.)-0.9887)))	3.3	0.19		--	3.3		--		
Benzo[a]anthracene	=(0.2*(EXP(0.5944*LN(Sed Conc.)-2.7078)))	7.2	0.043		--	7.2		--		
Benzo[a]pyrene	=(0.2*(EXP(0.975*LN(Sed Conc.)-2.0615)))	6.1	0.15		--	6.1		--		
Benzo[b]fluoranthene	=(0.2*0.31*Sed Conc.)	5.3	0.33		--	5.3		--		
Benzo[g,h,i]perylene	=(0.2*(EXP(1.1829*LN(Sed Conc.)-0.9313)))	3.3	0.32		--	3.3		--		
Benzo[k]fluoranthene	=(0.2*(EXP(0.8595*LN(Sed Conc.)-2.1579)))	5.4	0.10		--	5.4		--		
Chrysene	=(0.2*(EXP(0.5944*LN(Sed Conc.)-2.7078)))	7.6	0.045		--	7.6		--		
Dibenz[a,h]anthracene	=(0.2*0.13*Sed Conc.)	0.80	0.02		--	0.80		--		
Fluoranthene	=(0.2*0.5*Sed Conc.)	19	1.9		--	19		--		
Fluorene	=(0.2*(EXP(-0.8556*LN(Sed Conc.)-5.562)))	2.2	0.00039		--	2.2		--		
Indeno[1,2,3-cd]pyrene	=(0.2*0.11*Sed Conc.)	3.9	0.086		--	3.9		--		
Naphthalene	=(0.2*12.2*Sed Conc.)	0.77	1.9		--	0.77		--		
Phenanthrene	=(0.2*(EXP(0.6203*LN(Sed Conc.)-0.1665)))	19	1.05		--	19		--		
Pyrene	=(0.2*0.72*Sed Conc.)	16	2.3		--	16		--		
Total PAHs	NA	100	10.4		1 [a]	100	30.1	0.5	30.1	15.1

Notes:

Sediment to plant tissue BAFs are literature-based bioaccumulation factors (BAFs) for plants and a dry-to-wet conversion factor of 0.2 since plant tissues are typically 20% solids. Sources of literature BAFs for plants were USEPA 2007 and Bechtel Jacobs Company LLC 1998. BAFs are expressed as either regression equation between sediment and tissue concentrations or as a factor applied to the sediment concentration, as provided in the source. These BAFs for plants were taken from terrestrial plant studies since BAFs are not widely available for aquatic plants.

Sediment to invertebrate tissue BAFs are literature-based bioaccumulation factors (BAFs) for invertebrates and a dry-to-wet conversion factor of 0.3 since plant tissues are typically 30% solids. Sources of literature BAFs for invertebrates were USEPA 2007 and Bechtel Jacobs Company LLC 1998. BAFs are expressed as either regression equation between soil and tissue concentrations or as a factor applied to the soil concentration, as provided in the source.

Trophic transfer factors for fish were reported in Dillon et al. (1995) and the maximum values are shown here.

[a] BAF for PAHs and a trophic transfer factor for barium were not available and a value of 1 is used as a surrogate because it is unlikely that these chemicals biomagnify.

Table 11. Toxicity reference values for benthic invertebrates, amphibians, and fishes

	Sediment		Surface Water			
CoPEC	Benthic Invertebrate Sediment SL (mg/kg)	Source	Amphibian Value (mg/L)	Source	Fish Surface Water SL (mg/L)	Source
Arsenic	9.79	Buchman 2008, bkg	0.04	Birge 1978	0.15	CTDEEP 2011, CWQS
Barium	0.7	Buchman 2008, bkg	244	Dowden et al. 1965	0.0039	EPA 1996, ET (Tier II)
Cadmium	0.99	Buchman 2008, TEC	0.019	Ranatunge et al. 2012	0.000125	CTDEEP 2011, CWQS*
Chromium (Total)	43.4	Buchman 2008, TEC	0.03	Birge 1978	0.011	CTDEEP 2011, CWQS
Copper	31.6	Buchman 2008, TEC	0.015	Horne and Dunson 1995	0.0048	CTDEEP 2011, CWQS*
Lead	35.8	Buchman 2008, TEC	0.04	Birge 1978	0.0012	CTDEEP 2011, CWQS*
Mercury	0.18	Buchman 2008, TEC	0.001	Birge 1978	0.00077	CTDEEP 2011, CWQS
Nickel	22.7	Buchman 2008, TEC	0.05	Birge 1978	0.0289	CTDEEP 2011, CWQS*
Vanadium	50	Buchman 2008, bkg	0.25	Birge 1978	0.019	EPA 1996, ET (Tier II)
Zinc	121	Buchman 2008, TEC	0.01	Birge 1979	0.065	CTDEEP 2011, CWQS*
Methylnaphthalene, 2-	0.0202	BTAG RIII 2006, SLV	NR	NA	0.0047	BTAG RIII 2006, SLV
Acenaphthene	0.0067	BTAG RIII 2006, SLV	NR	NA	0.023	EPA 1996, ET (AWQC or FCV)
Acenaphthylene	0.0059	BTAG RIII 2006, SLV	NR	NA	4.84	Buchman 2008, CCC
Anthracene	0.0572	Buchman 2008, TEC	0.025	Kagan et al. 1984	0.00073	Buchman 2008, CCC
Benzo(a)anthracene	0.108	Buchman 2008, TEC	NR	NA	0.000027	Suter and Tsao, 1996 Tier II SCV
Benzo(a)pyrene	0.15	Buchman 2008, TEC	3.33	Saka et al. 2004	0.000014	Suter and Tsao, 1996 Tier II SCV
Benzo(b)fluoranthene	10.4	EPA 2003, R5 ESL	NR	NA	0.00907	EPA 2003, R5 ESL
Benzo(g,h,i)perylene	0.17	BTAG RIII 2006, SLV	NR	NA	0.00764	Buchman 2008, CCC
Benzo(k)fluoranthene	0.0272	Buchman 2008, TEL-H	NR	NA	NR	NA
Chrysene	0.166	Buchman 2008, TEC	NR	NA	NR	NA
Dibenz(a,h)anthracene	0.033	Buchman 2008, TEC	NR	NA	NR	NA
Fluoranthene	0.423	Buchman 2008, TEC	0.052	Hatch 1998	0.0081	EPA 1996, ET (AWQC or FCV)
Fluorene	0.0774	Buchman 2008, TEC	NR	NA	0.0039	EPA 1996, ET (Tier II)
Indeno(1,2,3-cd)pyrene	0.0173	Buchman 2008, TEL-H	NR	NA	0.00431	EPA 2003, R5 ESL
Naphthalene	0.176	Buchman 2008, TEC	2.1	Edmisten and Bantle 1982	0.024	EPA 1996, ET (Tier II)
Phenanthrene	0.204	Buchman 2008, TEC	NR	NA	0.0063	EPA 1996, ET (AWQC or FCV)
Pyrene	0.195	Buchman 2008, TEC	0.14	Kagan et al. 1987	0.000025	BTAG RIII 2006, SLV
Total PAHs	1.61	Buchman 2008, TEC	NR	NA	NR	NA

Notes:
NR - not reported
NA - not applicable
SL-screening level
PAHs - polycyclic aromatic hydrocarbons
See Tables 3 and 5 for source abbreviations.

Table 12. Toxicity reference values for avian wildlife

CoPEC	Test Species	Body Weight (kg)	Exposure Route	No-Effects Dose Concentration	Lowest Observed Effects Dose Concentration	Ingestion Rate	Endpoint	Duration of Study	Uncertainty Factor	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	References[g]
Arsenic as Arsenate	Mallard	1.043 [a]	oral in food	100 ppm	400 ppm	0.1 kg/day	reproduction	4 weeks	--	10	38	Stanley et al. (1994)
Barium	Chicks	0.121 [b]	oral in food	2,000 ppm	4,000 ppm	0.0126 kg/day[a]	mortality	4 weeks	0.1 [c]	21	42	Johnson et al. (1960)
Cadmium	Mallard	1.153	oral in food	15.2 ppm	210 ppm	0.110 kg/day	reproduction	90 days	--	1.45	20	White and Finley (1978)
Chromium 3+	Black duck	1.25	oral in food	10 ppm	50 ppm	0.15 kg/kg/day[d]	reproduction	10 months	--	1.5	7.5	Haseltine et al. (1985) as cited in Sample et al. (1996)
Copper	Mallard	0.8	oral in food	218.5 ppm	420 ppm	0.26 kg/kg/day	growth	35 days	--	5.68	10.9	Foster (1999)
Lead	American kestrels	0.144	oral in food	50 ppm	--	0.01 kg/day[e]	reproduction	7 months	--	3.75	25.5	Pattee (1984); Eco-SSL (2005)
Mercury, methyl	Various	--	dietary	--	--	--	reproduction	Chronic	--	0.05	0.5	Fuchsman et al. (2017)
Nickel	Mallard ducklings	0.782	oral in food	176 ppm	774 ppm	0.17 kg/kg/day	mortality	90 days	--	31	135	Cain and Pafford (1981)
Vanadium	Mallard	1.17	oral in food	110 ppm	--	0.10 kg/kg/day	mortality, growth	12 weeks	--	11	n/a	White and Dieter (1978)
Zinc	Mallard	1.043 [a]	oral in food	--	3000 ppm	0.03 kg/kg/day	reproduction	60 days	0.1 [f]	10.2	102	Gasaway and Buss (1974)
Total PAHs	European starling	0.055	gavage	2 mg/kg/day	20 mg/kg/day	--	growth	5 days	0.1 [c]	0.2	2	Trust et al. (1994)

Note: Dose concentrations and ingestion rates are expressed in wet weight unless otherwise noted.

bw - body weight
dw - dry weight
LOAEL - lowest-observed-adverse-effect level
NOAEL - no-observed-adverse-effect level
PAH - polycyclic aromatic hydrocarbon
TRV - toxicity reference value
UF - uncertainty factor
ww - wet weight

[a] U.S. EPA (1993).

[b] U.S. EPA (1988), mean at 5 weeks.

[c] Subchronic to Chronic UF (0.1); Acute to Chronic UF (0.01).

[d] Nagy (2001)

[e] Sample et al. (1996).

[f] LOAEL to NOAEL UF of 0.1.

[g] See Appendix D for full citations.

Table 13. Toxicity reference values for mammalian wildlife

	Test Organism Information											Raccoon[i]	
CoPEC	Test Species	Body Weight (kg)	Exposure Route	No-Effects Dose Concentration	Lowest Observed Effects Dose Concentration	Ingestion Rate	Endpoint	Duration of Study	Uncertainty Factor	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	References[h]	Body Weight (kg)	Final NOAEL (mg/kg/d)
Arsenic as Arsenate	Rabbit	4.4	oral in food	--	--	--	reproduction	18 days during gestation	--	0.75	3.0	Nemec et al. (1998)	6	0.69
Barium	Mouse	0.307	oral inwater	61 mg/kg/day	121 mg/kg/day	--	growth	92 days	0.1 [c]	6.1	12	Dietz et al. (1992)	6	2.9
Cadmium	Rat	0.303	oral gavage	1 mg/kg bw/day	10 mg/kg bw/day	--	reproduction	6 weeks through gestation	--	1.0	10	Sutou et al. (1980)	6	0.47
Chromium 3+	Mouse	0.0249	oral in food	--	100 ppm; 38.02% Cr3+ by MW	0.16 kg/kg/day	reproduction	35 days	0.1 [b]	0.60	5.96	Zahid et al. (1990)	6	0.15
Copper	Mink	1.0 [d]	oral in food	25 ppm and 60.5 ppm in food	50 ppm and 60.5 ppm in food	0.137 kg/kg bw-day[e]	kit mortality	357 days	--	12	15	Aulerich et al. (1982)	6	7.5
Lead	Rat	0.35 [f]	oral in food	141 ppm	1130 ppm	0.08 kg/kg/day	weight of weanlings and kidney histology	3 generations	--	11	90	Azar et al. (1973)	6	5.6
Mercury, methyl	Rat	0.35 [f]	oral in food	0.5 ppm	2.5 ppm	0.028 kg/day[g]	reproduction	3 generations	--	0.032	0.16	Verschuuren et al. (1976)	6	0.02
Nickel	Rat	0.35 [a]	oral in food	500 ppm; 22% Ni by MW	1,000 ppm; 22% Ni by MW	0.028 kg/day[g]	offspring body weight	3 generations	--	9	18	Ambrose et al. (1976)	6	4.4
Vanadium	Rat	0.35 [f]	oral in food	1.03 mg/kg/day	5.11 mg/kg/day	--	growth	10 weeks	0.1 [c]	0.103	0.511	Daniel and Lillie (1938)	6	0.05
Zinc	Sprague-Dawley rat	0.35 [a]	oral in diet	2,000 ppm	4,000 ppm	0.028 kg/day[g]	reproduction	16 days during gestation	--	160	320	Schlicker and Cox (1968)	6	79
Total PAHs	Mouse	0.038	oral in food	5 ppm	25 ppm	0.15 kg/kg/day	growth, mortality	2 years	--	0.8	3.8	Culp et al. (1998)	6	0.23

Note: Dose concentrations and ingestion rates are expressed in wet weight unless otherwise noted.

bw - body weight
dw - dry weight
LOAEL - lowest-observed-adverse-effect level
NOAEL - no-observed-adverse-effect level
PAH - polycyclic aromatic hydrocarbon
TRV - toxicity reference value
UF - uncertainty factor
ww - wet weight

[a] U.S. EPA (1988).
[b] LOAEL to NOAEL UF of 0.1.
[c] Subchronic to Chronic UF of 0.1.
[d] U.S. EPA (1993)
[e] Based on the observations of Bleavins and Aulerich (1981).
[f] U.S. EPA (1995).
[g] Calculated used allometric equation from U.S. EPA (1988).
[h] See Appendix D for full citations.
[i] TRVs for the raccoon are adjusted for differences in body weight between the test organisms and the raccoon (see report text for details).

Table 14. Benthic invertebrate assessment endpoint results - hazard quotients using sediment toxicity reference values

CoPEC	Units	MDC	Sediment Screening Level	HQ	Comment
Arsenic	mg/kg	7.3	9.79	0.7	Results do not indicate a potential risk
Barium	mg/kg	324	0.7	463	Results indicate a potential risk
Cadmium	mg/kg	2.9	0.99	3	Results indicate a potential risk
Chromium (Total)	mg/kg	66	43.4	2	Results indicate a potential risk
Copper	mg/kg	2190	31.6	69	Results indicate a potential risk
Lead	mg/kg	267	35.8	7	Results indicate a potential risk
Mercury	mg/kg	0.21	0.18	1	Results indicate a potential risk
Nickel	mg/kg	41.6	22.7	2	Results indicate a potential risk
Vanadium	mg/kg	109	50	2	Results indicate a potential risk
Zinc	mg/kg	606	121	5	Results indicate a potential risk
Methylnaphthalene, 2-	mg/kg	0.79	0.0202	39	Results indicate a potential risk
Acenaphthene	mg/kg	1.3	0.0067	194	Results indicate a potential risk
Acenaphthylene	mg/kg	1.4	0.0059	237	Results indicate a potential risk
Anthracene	mg/kg	3.3	0.0572	58	Results indicate a potential risk
Benzo(a)anthracene	mg/kg	7.2	0.108	67	Results indicate a potential risk
Benzo(a)pyrene	mg/kg	6.1	0.15	41	Results indicate a potential risk
Benzo(b)fluoranthene	mg/kg	5.3	10.4	0.5	Results do not indicate a potential risk
Benzo(g,h,i)perylene	mg/kg	3.3	0.17	19	Results indicate a potential risk
Benzo(k)fluoranthene	mg/kg	5.4	0.0272	199	Results indicate a potential risk
Chrysene	mg/kg	7.6	0.166	46	Results indicate a potential risk
Dibenz(a,h)anthracene	mg/kg	0.80	0.033	24	Results indicate a potential risk
Fluoranthene	mg/kg	19	0.423	45	Results indicate a potential risk
Fluorene	mg/kg	2.2	0.0774	28	Results indicate a potential risk
Indeno(1,2,3-cd)pyrene	mg/kg	3.9	0.0173	225	Results indicate a potential risk
Naphthalene	mg/kg	0.77	0.176	4	Results indicate a potential risk
Phenanthrene	mg/kg	19	0.204	93	Results indicate a potential risk
Pyrene	mg/kg	16	0.195	82	Results indicate a potential risk
Total PAHs	mg/kg	100	1.61	62	Results indicate a potential risk

Notes:
MDC - maximum detected concentration
HQ>1 are highlighted in yellow, indicating a potential risk.
PAHs - polycyclic aromatic hydrocarbons

Table 15. Amphibian and fish assessment endpoints results - hazard quotients for aquatic life using surface water toxicity reference values

CoPEC	Units	MDC/MRL[1]	Fish Surface Water SL	Fish Surface Water SL HQ	Amphibian Value	Amphibian Value HQ	Comment
Arsenic	mg/L	0.004	0.15	0.03	0.04	0.1	Results do not indicate a potential risk
Barium	mg/L	0.056	0.0039	14	244	0.0002	Results indicate a potential risk
Cadmium	mg/L	0.001	0.000125	8	0.019	0.05	Results indicate a potential risk
Chromium (Total)	mg/L	0.001	0.011	0.09	0.03	0.03	Results do not indicate a potential risk
Copper	mg/L	0.005	0.0048	1	0.015	0.3	Results indicate a potential risk
Lead	mg/L	0.002	0.0012	2	0.04	0.05	Results indicate a potential risk
Mercury	mg/L	0.0002	0.00077	0.3	0.001	0.2	Results do not indicate a potential risk
Nickel	mg/L	0.001	0.0289	0.03	0.05	0.02	Results do not indicate a potential risk
Vanadium	mg/L	0.002	0.019	0.1	0.25	0.008	Results do not indicate a potential risk
Zinc	mg/L	0.006	0.065	0.09	0.01	0.6	Results do not indicate a potential risk
Methylnaphthalene, 2-	mg/L	0.00099	0.0047	0.2	NR	NA	Results do not indicate a potential risk
Acenaphthene	mg/L	0.00005	0.023	0.002	NR	NA	Results do not indicate a potential risk
Acenaphthylene	mg/L	0.00005	4.84	0.00001	NR	NA	Results do not indicate a potential risk
Anthracene	mg/L	0.00005	0.00073	0.07	0.025	0.002	Results do not indicate a potential risk
Benzo(a)anthracene	mg/L	0.00005	0.000027	2	NR	NA	Results indicate a potential risk
Benzo(a)pyrene	mg/L	0.00005	0.000014	4	3.33	2E-05	Results indicate a potential risk
Benzo(b)fluoranthene	mg/L	0.00005	0.00907	0.006	NR	NA	Results do not indicate a potential risk
Benzo(g,h,i)perylene	mg/L	0.0002	0.00764	0.03	NR	NA	Results do not indicate a potential risk
Benzo(k)fluoranthene	mg/L	0.00005	NR	NA	NR	NA	No values to compute HQs
Chrysene	mg/L	0.00005	NR	NA	NR	NA	No values to compute HQs
Dibenz(a,h)anthracene	mg/L	0.00001	NR	NA	NR	NA	No values to compute HQs
Fluoranthene	mg/L	0.00005	0.0081	0.006	0.052	0.001	Results do not indicate a potential risk
Fluorene	mg/L	0.0001	0.0039	0.03	NR	NA	Results do not indicate a potential risk
Indeno(1,2,3-cd)pyrene	mg/L	0.00005	0.00431	0.01	NR	NA	Results do not indicate a potential risk
Naphthalene	mg/L	0.0001	0.024	0.004	2.1	5E-05	Results do not indicate a potential risk
Phenanthrene	mg/L	0.00005	0.0063	0.008	NR	NA	Results do not indicate a potential risk
Pyrene	mg/L	0.00005	0.000025	2	0.14	0.0004	Results indicate a potential risk
Total PAHs	mg/L	0.002	NR	NA	NR	NA	No values to compute HQs

Notes:
MDC - maximum detected concentration
MRL - maximum reporting limit
NR - not reported
NA - not applicable
HQ>1 are highlighted in yellow, indicating a potential risk.

[1] The MDC was used for barium and zinc, and the MRL was used for all other chemicals because they were non-detected CoPECs.

Table 16. Wildlife assessment endpoint results – hazard quotients for the mallard, great blue heron, and raccoon

	Mallard (aquatic plant consumer)		Great Blue Heron (fish and invertebrate consumer)		Raccoon (fish and invertebrate consumer)		
CoPEC	Total Chemical Intake (mg/kg/day)	HQ (unitless)	Total Chemical Intake (mg/kg/day)	HQ (unitless)	Total Chemical Intake (mg/kg/day)	HQ (unitless)	Comment
Arsenic	2.09E-02	0.002	1.34E-01	0.01	1.08E-01	0.2	Results do not indicate a potential risk
Barium	2.12E+00	0.1	1.22E+00	0.06	1.53E+00	0.5	Results do not indicate a potential risk
Cadmium	3.97E-02	0.03	2.46E-01	0.2	1.76E-01	0.4	Results do not indicate a potential risk
Chromium (Total)	1.95E-01	0.1	1.82E-01	0.1	2.65E-01	2	Results indicate a potential risk
Copper	4.89E+00	0.9	3.94E+00	0.7	7.32E+00	0.98	Results do not indicate a potential risk
Lead	6.33E-01	0.2	4.82E-01	0.1	8.93E-01	0.2	Results do not indicate a potential risk
Mercury	5.31E-03	0.1	2.07E-02	0.4	1.47E-02	0.9	Results do not indicate a potential risk
Nickel	1.24E-01	0.004	2.98E-01	0.01	2.93E-01	0.07	Results do not indicate a potential risk
Vanadium	1.97E-01	0.02	1.72E-01	0.02	3.48E-01	7	Results indicate a potential risk
Zinc	6.27E+00	0.6	8.84E+00	0.9	7.36E+00	0.09	Results do not indicate a potential risk
Total PAHs	1.80E+00	9	2.73E+00	14	2.09E+00	9	Results indicate a potential risk

Notes:

PAHs - polycyclic aromatic hydrocarbons

PAHs were evaluated as the sum of individual PAHs or total PAHs.

HQ>1 are highlighted in yellow, indicating a potential risk.

Table 17. Results of benthic invertebrates, aquatic life, and wildlife assessments using Site concentration data

	Benthic Invertebrates		Aquatic Life			Wildlife			
CoPEC	Sediment HQ	Comment	Fish Surface Water SL HQ	Amphibian Value HQ	Comment	Mallard HQ	Great Blue Heron HQ	Raccoon HQ	Comment
Arsenic	0.7	Results do not indicate a potential risk	0.03	0.1	Results do not indicate a potential risk	0.002	0.01	0.2	Results do not indicate a potential risk
Barium	463	Results indicate a potential risk	14	0.0002	Results indicate a potential risk	0.1	0.06	0.5	Results do not indicate a potential risk
Cadmium	3	Results indicate a potential risk	8	0.05	Results indicate a potential risk	0.03	0.2	0.4	Results do not indicate a potential risk
Chromium (Total)	2	Results indicate a potential risk	0.09	0.03	Results do not indicate a potential risk	0.1	0.1	2	Results indicate a potential risk
Copper	69	Results indicate a potential risk	1	0.3	Results indicate a potential risk	0.9	0.7	1	Results do not indicate a potential risk
Lead	7	Results indicate a potential risk	2	0.05	Results indicate a potential risk	0.2	0.1	0.2	Results do not indicate a potential risk
Mercury	1	Results indicate a potential risk	0.3	0.2	Results do not indicate a potential risk	0.1	0.4	0.9	Results do not indicate a potential risk
Nickel	2	Results indicate a potential risk	0.03	0.02	Results do not indicate a potential risk	0.004	0.01	0.07	Results do not indicate a potential risk
Vanadium	2	Results indicate a potential risk	0.1	0.008	Results do not indicate a potential risk	0.02	0.02	7	Results indicate a potential risk
Zinc	5	Results indicate a potential risk	0.09	0.6	Results do not indicate a potential risk	0.6	0.9	0.09	Results do not indicate a potential risk
Methylnaphthalene, 2-	39	Results indicate a potential risk	0.2	NA	Results do not indicate a potential risk				
Acenaphthene	194	Results indicate a potential risk	0.002	NA	Results do not indicate a potential risk				
Acenaphthylene	237	Results indicate a potential risk	0.00001	NA	Results do not indicate a potential risk				
Anthracene	58	Results indicate a potential risk	0.07	0.002	Results do not indicate a potential risk				
Benzo(a)anthracene	67	Results indicate a potential risk	2	NA	Results indicate a potential risk				
Benzo(a)pyrene	41	Results indicate a potential risk	4	2E-05	Results indicate a potential risk				
Benzo(b)fluoranthene	0.5	Results do not indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Benzo(g,h,i)perylene	19	Results indicate a potential risk	0.03	NA	Results do not indicate a potential risk				
Benzo(k)fluoranthene	199	Results indicate a potential risk	NA	NA	No values to compute HQs				evaluated as Total PAHs
Chrysene	46	Results indicate a potential risk	NA	NA	No values to compute HQs				
Dibenz(a,h)anthracene	24	Results indicate a potential risk	NA	NA	No values to compute HQs				
Fluoranthene	45	Results indicate a potential risk	0.006	0.001	Results do not indicate a potential risk				
Fluorene	28	Results indicate a potential risk	0.03	NA	Results do not indicate a potential risk				
Indeno(1,2,3-cd)pyrene	225	Results indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Naphthalene	4	Results indicate a potential risk	0.004	5E-05	Results do not indicate a potential risk				
Phenanthrene	93	Results indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Pyrene	82	Results indicate a potential risk	2	0.0004	Results indicate a potential risk				
Total PAHs	62	Results indicate a potential risk	NA	NA	No values to compute HQs	9	14	9	Results indicate a potential risk

Notes:
HQ>1 are highlighted in yellow, indicating a potential risk.
PAHs - polycyclic aromatic hydrocarbons

Table 18. Summary statistics of chemistry data for sediment samples in the Hockanum River upstream of the Site

	Total No. Samples	Detects Count	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)
CT ETPH	5	5	890	NA
Antimony	5	0	NA	1.2
Arsenic	5	2	1.4	1.2
Barium	5	5	26	NA
Beryllium	5	0	NA	0.5
Cadmium	5	0	NA	1.2
Chromium (Total)	5	5	18	NA
Copper	5	5	24	NA
Lead	5	5	57	NA
Mercury	5	0	NA	0.02
Nickel	5	5	7.6	7.6
Selenium	5	0	NA	1.6
Silver	5	0	NA	1.2
Thallium	5	0	NA	0.5
Vanadium	5	5	35	NA
Zinc	5	5	150	NA
Methylnaphthalene, 2-	5	5	0.091	NA
Acenaphthene	5	5	0.15	NA
Acenaphthylene	5	5	0.89	NA
Anthracene	5	5	0.79	NA
Benzo(a)anthracene	5	5	2.3	NA
Benzo(a)pyrene	5	5	2.1	NA
Benzo(b)fluoranthene	5	5	2.5	NA
Benzo(g,h,i)perylene	5	5	1.7	NA
Benzo(k)fluoranthene	5	5	0.81	NA
Chrysene	5	5	2.3	NA
Dibenz(a,h)anthracene	5	5	0.51	NA
Fluoranthene	5	5	5.1	NA
Fluorene	5	5	0.34	NA
Indeno(1,2,3-cd)pyrene	5	5	1.5	NA
Phenanthrene	5	5	3.3	NA
Pyrene	5	5	4.7	NA
Naphthalene	5	5	0.43	NA

Notes:
Conc. - concentration
mg/kg - milligram per killogram
NA - not available

Table 19. Summary statistics of chemistry data for surface water samples in the Hockanum River upstream of the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
CT ETPH	2	0	NA	75
Antimony (Total)	2	0	NA	2
Antimony (Dissolved)	2	0	NA	2
Arsenic (Total)	2	0	NA	2
Arsenic (Dissolved)	2	0	NA	2
Barium (Total)	2	2	58	NA
Barium (Dissolved)	2	2	54	NA
Beryllium (Total)	2	0	NA	0.8
Beryllium (Dissolved)	2	0	NA	0.8
Cadmium (Total)	2	0	NA	2
Cadmium (Dissolved	2	0	NA	2
Chromium (Total)	2	0	NA	4
Chromium (Dissolved)	2	0	NA	4
Copper (Total)	2	0	NA	4
Copper (Dissolved)	2	0	NA	4
Lead (Total)	2	0	NA	1.2
Lead (Dissolved)	2	0	NA	1.2
Mercury (Total)	2	0	NA	0.20
Mercury (Dissolved)	2	0	NA	0.20
Nickel (Total)	2	0	NA	4
Nickel (Dissolved)	2	0	NA	4
Selenium (Total)	2	0	NA	2.5
Selenium (Dissolved)	2	0	NA	2.5
Silver (Total)	2	0	NA	2
Silver (Dissolved)	2	0	NA	2
Thallium (Total)	2	0	NA	0.8
Thallium (Dissolved)	2	0	NA	0.8
Vanadium (Total)	2	0	NA	4
Vanadium (Dissolved)	2	0	NA	4
Zinc (Total)	2	0	NA	16
Zinc (Dissolved)	2	0	NA	16
Methylnaphthalene, 2-	2	0	NA	0.05
Acenaphthene	2	0	NA	0.05
Acenaphthylene	2	0	NA	0.05
Anthracene	2	0	NA	0.05
Benzo(a)anthracene	2	0	NA	0.05
Benzo(a)pyrene	2	0	NA	0.05
Benzo(b)fluoranthene	2	0	NA	0.05
Benzo(g,h,i)perylene	2	0	NA	0.05
Benzo(k)fluoranthene	2	0	NA	0.05
Chrysene	2	0	NA	0.05
Dibenz(a,h)anthracene	2	0	NA	0.05
Fluoranthene	2	0	NA	0.05
Fluorene	2	0	NA	0.05

Table 19. Summary statistics of chemistry data for surface water samples in the Hockanum River upstream of the Site

	Total No. Samples	Detects Count	Maximum Detected Conc (ug/L)	Maximum Reporting Limit (ug/L)
Indeno(1,2,3-cd)pyrene	2	0	NA	0.05
Phenanthrene	2	0	NA	0.05
Pyrene	2	0	NA	0.05
Naphthalene	2	0	NA	0.2

Notes:
Conc. - concentration
ug/L - microgram per liter
NA - not available

Table 20. Comparison of Site exposure point concentrations and upstream exposure point concentrations

	Site				Upstream			
	Sediment		Surface Water		Sediment		Surface Water	
CoPEC	Value Used (mg/kg)	Basis	Value Used (mg/L)	Basis	Value Used (mg/kg)	Basis	Value Used (mg/L)	Basis
Arsenic	7.3	MDC	0.004	MRL	1.4	MDC	0.002	MRL
Barium	324	MDC	0.056	MDC	26	MDC	0.058	MDC
Cadmium	2.9	MDC	0.001	MRL	1.2	MRL	0.002	MRL
Chromium (Total)	66.4	MDC	0.001	MRL	18	MDC	0.004	MRL
Copper	2190	MDC	0.005	MRL	24	MDC	0.004	MRL
Lead	267	MDC	0.002	MRL	57	MDC	0.0012	MRL
Mercury	0.21	MDC	0.0002	MRL	0.02	MRL	0.0002	MRL
Nickel	41.6	MDC	0.001	MRL	7.6	MDC	0.004	MRL
Vanadium	109	MDC	0.002	MRL	35	MDC	0.004	MRL
Zinc	606	MDC	0.006	MDC	150	MDC	0.016	MRL
Methylnaphthalene, 2-	0.79	MDC	0.00099	MRL	0.091	MDC	0.00005	MRL
Acenaphthene	1.3	MDC	0.00005	MRL	0.15	MDC	0.00005	MRL
Acenaphthylene	1.4	MDC	0.00005	MRL	0.89	MDC	0.00005	MRL
Anthracene	3.3	MDC	0.00005	MRL	0.79	MDC	0.00005	MRL
Benzo(a)anthracene	7.2	MDC	0.00005	MRL	2.3	MDC	0.00005	MRL
Benzo(a)pyrene	6.1	MDC	0.00005	MRL	2.1	MDC	0.00005	MRL
Benzo(b)fluoranthene	5.3	MDC	0.00005	MRL	2.5	MDC	0.00005	MRL
Benzo(g,h,i)perylene	3.3	MDC	0.0002	MRL	1.7	MDC	0.00005	MRL
Benzo(k)fluoranthene	5.4	MDC	0.00005	MRL	0.81	MDC	0.00005	MRL
Chrysene	7.6	MDC	0.00005	MRL	2.3	MDC	0.00005	MRL
Dibenz(a,h)anthracene	0.80	MDC	0.00001	MRL	0.51	MDC	0.00005	MRL
Fluoranthene	19	MDC	0.00005	MRL	5.1	MDC	0.00005	MRL
Fluorene	2.2	MDC	0.0001	MRL	0.34	MDC	0.00005	MRL
Indeno(1,2,3-cd)pyrene	3.9	MDC	0.00005	MRL	1.5	MDC	0.00005	MRL
Naphthalene	0.77	MDC	0.0001	MRL	0.43	MDC	0.0002	MRL
Phenanthrene	19	MDC	0.00005	MRL	3.3	MDC	0.00005	MRL
Pyrene	16	MDC	0.00005	MRL	4.7	MDC	0.00005	MRL
Total PAHs	100	MDC	0.002	MRL	28	MDC	0.002	MRL

Notes:

CoPEC - contaminant of potential ecological concern

MDC - maximum detected concentration

MRL - maximum reporting limit

For metal EPCs in surface water the maximum value between the dissolved and total measurement was used.

PAHs - polycyclic aromatic hydrocarbons

Table 21. Results of benthic invertebrates, aquatic life, and wildlife assessments using upstream concentration data

	Benthic Invertebrates		Aquatic Life			Wildlife			
CoPEC	Sediment HQ	Comment	Fish Surface Water SL HQ	Amphibian Value HQ	Comment	Mallard HQ	Great Blue Heron HQ	Raccoon HQ	Comment
Arsenic	0.1	Results do not indicate a potential risk	0.01	0.05	Results do not indicate a potential risk	0.0004	0.004	0.04	Results do not indicate a potential risk
Barium	37	Results indicate a potential risk	15	0.0002	Results indicate a potential risk	0.008	0.005	0.04	Results do not indicate a potential risk
Cadmium	1	Results indicate a potential risk	16	0.1	Results indicate a potential risk	0.02	0.09	0.2	Results do not indicate a potential risk
Chromium (Total)	0.4	Results do not indicate a potential risk	0.4	0.1	Results do not indicate a potential risk	0.04	0.07	0.7	Results do not indicate a potential risk
Copper	0.8	Results do not indicate a potential risk	0.8	0.3	Results do not indicate a potential risk	0.04	0.1	0.08	Results do not indicate a potential risk
Lead	2	Results indicate a potential risk	1.0	0.03	Results do not indicate a potential risk	0.05	0.03	0.04	Results do not indicate a potential risk
Mercury	0.1	Results do not indicate a potential risk	0.3	0.2	Results do not indicate a potential risk	0.03	0.2	0.4	Results do not indicate a potential risk
Nickel	0.3	Results do not indicate a potential risk	0.1	0.08	Results do not indicate a potential risk	0.0009	0.02	0.09	Results do not indicate a potential risk
Vanadium	0.7	Results do not indicate a potential risk	0.2	0.02	Results do not indicate a potential risk	0.006	0.005	2	Results indicate a potential risk
Zinc	1	Results indicate a potential risk	0.2	2	Results indicate a potential risk	0.3	0.6	0.06	Results do not indicate a potential risk
Methylnaphthalene, 2-	5	Results indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Acenaphthene	22	Results indicate a potential risk	0.002	NA	Results do not indicate a potential risk				
Acenaphthylene	151	Results indicate a potential risk	1E-05	NA	Results do not indicate a potential risk				
Anthracene	14	Results indicate a potential risk	0.07	0.002	Results do not indicate a potential risk				
Benzo(a)anthracene	21	Results indicate a potential risk	2	NA	Results indicate a potential risk				
Benzo(a)pyrene	14	Results indicate a potential risk	4	2E-05	Results indicate a potential risk				
Benzo(b)fluoranthene	0.2	Results do not indicate a potential risk	0.006	NA	Results do not indicate a potential risk				
Benzo(g,h,i)perylene	10	Results indicate a potential risk	0.007	NA	Results do not indicate a potential risk				
Benzo(k)fluoranthene	30	Results indicate a potential risk	NA	NA	No values to compute HQs				evaluated as Total PAHs
Chrysene	14	Results indicate a potential risk	NA	NA	No values to compute HQs				
Dibenz(a,h)anthracene	15	Results indicate a potential risk	NA	NA	No values to compute HQs				
Fluoranthene	12	Results indicate a potential risk	0.006	0.001	Results do not indicate a potential risk				
Fluorene	4	Results indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Indeno(1,2,3-cd)pyrene	87	Results indicate a potential risk	0.01	NA	Results do not indicate a potential risk				
Naphthalene	2	Results indicate a potential risk	0.008	1E-04	Results do not indicate a potential risk				
Phenanthrene	16	Results indicate a potential risk	0.008	NA	Results do not indicate a potential risk				
Pyrene	24	Results indicate a potential risk	2	0.0004	Results indicate a potential risk				
Total PAHs	18	Results indicate a potential risk	NA	NA	No values to compute HQs	3	4	3	Results indicate a potential risk

Notes:
HQ>1 are highlighted in yellow, indicating a potential risk.
PAHs - polycyclic aromatic hydrocarbons

Appendix A

Analytical Data used in the Screening-Level Ecological Risk Assessment

Table A-1. Current sediment data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SED-01	SED-02	SED-DUP-02	SED-03	SED-04	SED-05	SED-06	SED-06A	SED-06B	SED-06C	SED-07	SED-DUP-07	SED-08	SED-09	SED-201	SED-202
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	2/24/2021	2/24/2021
Lab Sample ID	BZ40749	BZ40750	BZ40755	BZ40751	BZ40752	BZ40753	BZ40754	CB20637	CB20638	CB20639	CB20634	CB20640	CB20635	CB20636	460-228733-1	460-228733-2
Hydrocarbon (mg/Kg)																
CT ETPH	170	310	250	<290	<290	330	1,100	NM	NM	NM	91	79	100	630	540	1,400
Metals (mg/Kg)																
Antimony	<4	<4.4	<4.1	<3.8	<3.5	<4.6	<4.6	NM	NM	NM	<3.6	<3.9	<4.3	<22	<1.1	<1.4
Arsenic	<0.79	2.26	1.35	1.5	2.1	1.26	3.95	NM	NM	NM	<0.73	<0.77	<0.85	7.3	2.5	1.9
Barium	29	49.5	36.3	27.5	40.6	29.6	24.5	NM	NM	NM	30.3	27.5	23.7	324	28	52
Beryllium	<0.32	<0.36	<0.33	<0.3	<0.28	<0.37	<0.37	NM	NM	NM	<0.29	<0.31	<0.34	<1.8	<0.43	<0.57
Cadmium	<0.4	<0.44	<0.41	0.4	0.89	<0.46	0.94	NM	NM	NM	<0.36	<0.39	<0.43	2.9	<1.1	<1.4
Chromium (Total)	9.22	17.5	10.1	10.2	14.6	11.3	17.4	NM	NM	NM	7.1	7.83	6.61	66.4	12	16
Copper	16.1	26.1	28.4	27.6	46.4	20	2,190	22.1	28.9	83.7	13.2	9.5	10	149	54	38
Lead	37.7	64.1	46.1	26.1	78.2	28.8	153	NM	NM	NM	43.7	33.1	22.2	267	33	72
Mercury	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.1	NM	NM	NM	<0.03	<0.03	<0.03	0.21	<0.019	0.049
Nickel	6.81	8.7	7.25	7.53	9.02	7.97	12.2	NM	NM	NM	7.6	5.25	6.37	41.6	8.9	7.7
Selenium	<1.6	<1.8	<1.6	<1.5	<1.4	<1.8	<1.8	NM	NM	NM	<1.5	<1.5	<1.7	<8.9	<1.3	<1.8
Silver	<0.4	<0.44	<0.41	<0.38	<0.35	<0.46	<0.46	NM	NM	NM	<0.36	<0.39	<0.43	<2.2	<1.1	<1.4
Thallium	<3.6	<4	<3.7	<3.4	<3.2	<4.1	<4.1	NM	NM	NM	<3.3	<3.5	<3.8	<20	<0.43	<0.57
Vanadium	21.7	37.3	29.5	31.9	41.5	31.7	26.5	NM	NM	NM	16	16.6	15.2	109	19	24
Zinc	53.2	77.4	86.8	77.6	88.5	70.9	292	NM	NM	NM	57.9	60.8	45.5	606	61	100
Inorganics (mg/Kg)																
Cyanide (Total)	<0.61	<0.68	<0.59	<0.59	<0.57	<0.61	<0.59	NM	NM	NM	NM	NM	NM	NM	NM	NM
PCBs (mg/Kg)																
Aroclor-1016	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1221	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1232	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1242	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1248	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1254	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1260	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1262	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Aroclor-1268	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
PCBs (Total)	<0.44	<0.45	<0.42	<0.39	<0.38	<0.43	<0.43	NM	NM	NM	<0.4	<0.41	<0.43	<0.43	<0.081	<0.11
Semi-Volatile Organic Compounds (ug/Kg)																
Tetrachlorobenzene, 1,2,4,5-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Diphenylhydrazine, 1,2-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Trichlorophenol, 2,4,5-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Trichlorophenol, 2,4,6-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dichlorophenol, 2,4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dimethylphenol, 2,4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dinitrophenol, 2,4-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Dinitrotoluene, 2,4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dinitrotoluene, 2,6-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Chloronaphthalene, 2-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Chlorophenol, 2-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Methylnaphthalene, 2-	420	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	790	<160
Methylphenol, 2-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Nitroaniline, 2-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Nitrophenol, 2-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Methylphenol, 3&4 (Cresol, m&p-)	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Dichlorobenzidine, 3,3-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Nitroaniline, 3-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Dinitro-2-methylphenol, 4,6-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Bromophenyl Phenyl Ether, 4-	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Chloro-3-methylphenol, 4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Chloroanilne, p- (4-Chloroaniline)	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Chlorophenyl-phenylether, 4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Nitroaniline, 4-	<710	<710	<680	<610	<590	<700	<6900	NM	NM	NM	<650	<660	<700	<3500	NM	NM
Nitrophenol, 4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Acenaphthene	1,300	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	1200	73
Acenaphthylene	380	420	490	580	290	410	<3000	NM	NM	NM	<280	<290	330	<1500	1400	660
Acetophenone	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Aniline	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Anthracene	3,300	900	790	880	<260	590	<3000	NM	NM	NM	<280	<290	600	<1500	2900	530
Benzo(a)anthracene	7,200	3,000	2,700	4,000	1,000	1,900	3,900	NM	NM	NM	700	710	2,400	<1500	3800	1600
Benzidine	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Benzo(a)pyrene	6,100	2,700	2,400	3,600	1,100	1,800	3,600	NM	NM	NM	770	840	2,400	1,900	3200	2100

Table A-1. Current sediment data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SED-01	SED-02	SED-DUP-02	SED-03	SED-04	SED-05	SED-06	SED-06A	SED-06B	SED-06C	SED-07	SED-DUP-07	SED-08	SED-09	SED-201	SED-202
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	2/24/2021	2/24/2021
Lab Sample ID	BZ40749	BZ40750	BZ40755	BZ40751	BZ40752	BZ40753	BZ40754	CB20637	CB20638	CB20639	CB20634	CB20640	CB20635	CB20636	460-228733-1	460-228733-2
Benzo(b)fluoranthene	5,300	2,800	2,200	3,100	890	1,700	<3000	NM	NM	NM	1,200	1,400	4,100	3,700	3400	2700
Benzo(g,h,i)perylene	3,300	1,600	1,400	1,800	780	1,100	<3000	NM	NM	NM	<280	<290	<300	<1500	2000	1800
Benzo(k)fluoranthene	5,400	2,600	2,100	3,400	1,000	1,700	3,400	NM	NM	NM	420	530	1,400	<1500	1200	670
Benzoic acid	<880	<890	<850	<760	<740	<870	<8600	NM	NM	NM	<810	<820	<870	<4400	NM	NM
bis(2-Chloroethoxy)methane	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
bis(2-Chloroethyl)ether	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
bis(2-Chloroisopropyl)ether	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
bis(2-Ethylhexyl)phthalate	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Butyl benzyl phthalate	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Carbazole	1,500	660	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Chrysene	7,600	3,500	3,000	4,100	1,200	2,100	4,700	NM	NM	NM	790	840	2,600	2,200	3700	2100
Dibenz(a,h)anthracene	800	<310	<300	430	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	550	450
Dibenzofuran	1,100	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Diethylphthalate	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dimethyl phthalate	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Di-N-Butyl Phthalate	<880	<890	<850	<760	<740	<870	<8600	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Di-N-Octyl Phthalate	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Fluoranthene	19,000	7,100	6,100	6,600	1,500	3,400	7,000	NM	NM	NM	1,600	1,700	5,200	3,600	9300	3800
Fluorene	1,400	350	350	310	<260	320	<3000	NM	NM	NM	<280	<290	<300	<1500	2200	130
Hexachlorobenzene	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Hexachlorocyclopentadiene	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Hexachloroethane	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Indeno(1,2,3-cd)pyrene	3,900	1,700	1,500	2,000	770	1,100	<3000	NM	NM	NM	<280	<290	440	<1500	1700	1500
Isophorone	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Nitrobenzene	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
N-Nitrosodimethylamine	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
N-Nitroso-di-N-propylamine	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
N-Nitrosodiphenylamine	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Pentachloronitrobenzene	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Pentachlorophenol	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Phenanthrene	19,000	4,300	3,800	2,500	810	2,200	5,500	NM	NM	NM	1,200	960	2,800	<1500	12000	1600
Phenol	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Pyrene	16,000	5,600	5,000	6,300	1,600	3,100	8,300	NM	NM	NM	1,500	1,600	4,300	3,200	8800	3900
Pyridine	<440	<440	<430	<380	<370	<440	<4300	NM	NM	NM	<400	<410	<440	<2200	NM	NM
Naphthalene	770	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	370	<160
Trichlorobenzene,1,2,4-	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dichlorobenzene, 1,2- (o-DCB)	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dichlorobenzene, 1,3-(m-DCB)	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Dichlorobenzene, 1,4- (p-DCB)	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Hexachlorobutadiene	<310	<310	<300	<270	<260	<310	<3000	NM	NM	NM	<280	<290	<300	<1500	NM	NM
Volatile Organic Compounds (ug/Kg)																
Naphthalene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Tetrachloroethane, 1,1,1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trichloroethane, 1,1,1-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Tetrachloroethane, 1,1,2,2-	<2.9	<3.9	<4.2	<3.2	<3.9	<3.7	<3.5	NM	NM	NM	<3.7	<4	<3.6	<20	NM	NM
Trichlorotrifluoroethane, 1,1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<12	<13	<12	<65	NM	NM
Trichloroethane, 1,1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloroethane, 1,1-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloroethene, 1,1-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropene, 1,1-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trichlorobenzene, 1,2,3-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trichloropropane, 1,2,3-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trichlorobenzene,1,2,4-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trimethylbenzene, 1,2,4-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dibromo-3-chloropropane,1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichlorobenzene, 1,2- (o-DCB)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloroethane, 1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropane, 1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trimethylbenzene, 1,3,5-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichlorobenzene, 1,3-(m-DCB)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropane, 1,3-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichlorobenzene, 1,4- (p-DCB)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropane, 2,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chlorotoluene, 2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Methyl butyl ketone (2-Hexanone)	<24	<33	<35	<27	<32	<31	<29	NM	NM	NM	<31	<33	<30	<160	NM	NM

Table A-1. Current sediment data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SED-01	SED-02	SED-DUP-02	SED-03	SED-04	SED-05	SED-06	SED-06A	SED-06B	SED-06C	SED-07	SED-DUP-07	SED-08	SED-09	SED-201	SED-202
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	8/28/2018	2/24/2021	2/24/2021
Lab Sample ID	BZ40749	BZ40750	BZ40755	BZ40751	BZ40752	BZ40753	BZ40754	CB20637	CB20638	CB20639	CB20634	CB20640	CB20635	CB20636	460-228733-1	460-228733-2
Isopropyltoluene, 2- (o-Cymene)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chlorotoluene, 4-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Isopropyltoluene, 4- (p-Cymene)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	<24	<33	<35	<27	<32	<31	<29	NM	NM	NM	<31	<33	<30	<160	NM	NM
Acetone	<240	<330	<350	<270	<320	<310	<290	NM	NM	NM	<310	<330	<300	<1600	NM	NM
Acrylonitrile	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Benzene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Bromobenzene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Bromochloromethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Bromodichloromethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Bromoform	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Bromomethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Butylbenzene, n-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Butylbenzene, sec-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Butylbenzene, tert-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Carbon disulfide	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Carbon tetrachloride	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chlorobenzene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chloroethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chloroform	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Chloromethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloroethene, cis-1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropene, cis-1,3-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dibromochloromethane	<2.9	<3.9	<4.2	<3.2	<3.9	<3.7	<3.5	NM	NM	NM	<3.7	<4	<3.6	<20	NM	NM
Dibromomethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichlorodifluoromethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Ethylbenzene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Ethylene Dibromide (EDB)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Hexachlorobutadiene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Isopropylbenzene (cumene)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Xylene, m,p-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Methyl ethyl ketone	<29	<39	<42	<32	<39	<37	<35	NM	NM	NM	<37	<40	<36	<200	NM	NM
Methyl Tert-Butyl Ether (MTBE)	<9.6	<13	<14	<11	<13	<12	<12	NM	NM	NM	<12	<13	<12	<65	NM	NM
Methylene Chloride (Dichloromethane)	<9.6	<13	<14	<11	<13	<12	<12	NM	NM	NM	<12	<13	<12	<65	NM	NM
Propylbenzene, n-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Xylene, o-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Styrene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Tetrachloroethylene (PCE)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Tetrahydrofuran	<9.6	<13	<14	<11	<13	<12	<12	NM	NM	NM	<12	<13	<12	<65	NM	NM
Toluene	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	240	NM	NM
Dichloroethene, trans-1,2-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloropropene, trans-1,3-	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Dichloro-2-butene, trans-1,4-	<9.6	<13	<14	<11	<13	<12	<12	NM	NM	NM	<12	<13	<12	<65	NM	NM
Trichloroethylene (TCE)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Trichlorofluoromethane	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Vinyl Chloride	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Xylene (Total)	<4.8	<6.5	<7	<5.4	<6.4	<6.1	<5.8	NM	NM	NM	<6.2	<6.6	<6.1	<33	NM	NM
Other (mg/Kg)																
Total Organic Carbon	19,000	17,000	25,000	5,100	6,200	10,000	24,000	NM	NM	NM	NM	NM	NM	NM	NM	NM

Notes:
NM - not measured
ug/Kg - microgram per kilogram
mg/Kg - milligram per kilogram

Table A-2. Current surface water data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-01	SW-DUP-01	SW-02	SW-03	SW-04
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17
Lab Sample ID	BZ40757	BZ40761	BZ40758	BZ40759	BZ40760
Hydrocarbon (mg/L)					
CT ETPH	<0.066	<0.066	<0.068	<0.068	<0.070
Metals (ug/L)					
Antimony	<5	<5	<5	<5	<5
Antimony (Dissolved)	<5	<5	<5	<5	<5
Arsenic	<4	<4	<4	<4	<4
Arsenic (Dissolved)	<4	<4	<4	<4	<4
Barium	50	51	53	47	49
Barium (Dissolved)	46	46	56	47	48
Beryllium	<1	<1	<1	<1	<1
Beryllium (Dissolved)	<1	<1	<1	<1	<1
Cadmium	<1	<1	<1	<1	<1
Cadmium (Dissolved)	<1	<1	<1	<1	<1
Chromium	<1	<1	<1	<1	<1
Chromium (Dissolved)	1	<1	1	<1	<1
Copper	<5	<5	<5	<5	<5
Copper (Dissolved)	<5	<5	<5	<5	<5
Lead	<2	<2	<2	<2	<2
Lead (Dissolved)	<2	<2	<2	<2	<2
Mercury	<0.200	<0.200	<0.200	<0.200	<0.200
Mercury (Dissolved)	<0.200	<0.200	<0.200	<0.200	<0.200
Nickel	<1	<1	<1	<1	<1
Nickel (Dissolved)	<1	<1	<1	<1	<1
Selenium	<10	<10	<10	<10	<10
Selenium (Dissolved)	<11	<11	<11	<11	<11
Silver	<1	<1	<1	<1	<1
Silver (Dissolved)	<1	<1	<1	<1	<1
Thallium	<1	<1	<1	<1	<1
Thallium (Dissolved)	<2	<2	<2	<2	<2
Vanadium	<2	<2	<2	<2	<2
Vanadium (Dissolved)	<2	<2	<2	<2	<2
Zinc	2	3	<2	<2	<2
Zinc (Dissolved)	4	3	4	3	6
Inorganics (mg/L)					
Cyanide (Total)	<0.010	<0.010	<0.010	<0.010	<0.010
Semi-Volatile Organic Compounds (ug/L)					
Tetrachlorobenzene, 1,2,4,5-	<0.47	<0.47	<0.49	<0.49	<0.49
Diphenylhydrazine, 1,2-	<4.7	<4.7	<4.9	<4.9	<4.9
Trichlorophenol, 2,4,5-	<0.94	<0.94	<0.97	<0.98	<0.99
Trichlorophenol, 2,4,6-	<0.94	<0.94	<0.97	<0.98	<0.99
Dichlorophenol, 2,4-	<0.94	<0.94	<0.97	<0.98	<0.99
Dimethylphenol, 2,4-	<0.94	<0.94	<0.97	<0.98	<0.99
Dinitrophenol, 2,4-	<0.94	<0.94	<0.97	<0.98	<0.99
Dinitrotoluene, 2,4-	<4.7	<4.7	<4.9	<4.9	<4.9
Dinitrotoluene, 2,6-	<4.7	<4.7	<4.9	<4.9	<4.9
Chloronaphthalene, 2-	<4.7	<4.7	<4.9	<4.9	<4.9
Chlorophenol, 2-	<0.94	<0.94	<0.97	<0.98	<0.99
Methylnaphthalene, 2-	<0.94	<0.94	<0.97	<0.98	<0.99

Table A-2. Current surface water data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-01	SW-DUP-01	SW-02	SW-03	SW-04
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17
Lab Sample ID	BZ40757	BZ40761	BZ40758	BZ40759	BZ40760
Methylphenol, 2-	<0.94	<0.94	<0.97	<0.98	<0.99
Nitroaniline, 2-	<4.7	<4.7	<4.9	<4.9	<4.9
Nitrophenol, 2-	<0.94	<0.94	<0.97	<0.98	<0.99
Methylphenol, 3&4 (Cresol, m&p-)	<9.4	<9.4	<9.7	<9.8	<9.9
Dichlorobenzidine, 3,3-	<4.7	<4.7	<4.9	<4.9	<4.9
Nitroaniline, 3-	<4.7	<4.7	<4.9	<4.9	<4.9
Dinitro-2-methylphenol, 4,6-	<0.94	<0.94	<0.97	<0.98	<0.99
Bromophenyl Phenyl Ether, 4-	<4.7	<4.7	<4.9	<4.9	<4.9
Chloro-3-methylphenol, 4-	<0.94	<0.94	<0.97	<0.98	<0.99
Chloroanilne, p- (4-Chloroaniline)	<4.7	<4.7	<4.9	<4.9	<4.9
Chlorophenyl-phenylether, 4-	<0.94	<0.94	<0.97	<0.98	<0.99
Nitroaniline, 4-	<4.7	<4.7	<4.9	<4.9	<4.9
Nitrophenol, 4-	<0.94	<0.94	<0.97	<0.98	<0.99
Acenaphthene	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthylene	<0.05	<0.05	<0.05	<0.05	<0.05
Acetophenone	<4.7	<4.7	<4.9	<4.9	<4.9
Aniline	<4.7	<4.7	<4.9	<4.9	<4.9
Anthracene	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)anthracene	<0.05	<0.05	<0.05	<0.05	<0.05
Benzidine	<4.7	<4.7	<4.9	<4.9	<4.9
Benzo(a)pyrene	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	<0.19	<0.19	<0.19	<0.20	<0.20
Benzo(k)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05
Benzoic acid	<47	<47	<49	<49	<49
bis(2-Chloroethoxy)methane	<4.7	<4.7	<4.9	<4.9	<4.9
bis(2-Chloroethyl)ether	<0.94	<0.94	<0.97	<0.98	<0.99
bis(2-Chloroisopropyl)ether	<4.7	<4.7	<4.9	<4.9	<4.9
bis(2-Ethylhexyl)phthalate	<0.47	<0.47	<0.49	<0.49	<0.49
Butyl benzyl phthalate	<4.7	<4.7	<4.9	<4.9	<4.9
Carbazole	<4.7	<4.7	<4.9	<4.9	<4.9
Chrysene	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	<0.01	<0.01	<0.01	<0.01	<0.01
Dibenzofuran	<0.05	<0.05	<0.05	<0.05	<0.05
Diethylphthalate	<4.7	<4.7	<4.9	<4.9	<4.9
Dimethyl phthalate	<4.7	<4.7	<4.9	<4.9	<4.9
Di-N-Butyl Phthalate	<4.7	<4.7	<4.9	<4.9	<4.9
Di-N-Octyl Phthalate	<4.7	<4.7	<4.9	<4.9	<4.9
Fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	<0.09	<0.09	<0.10	<0.10	<0.10
Hexachlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorocyclopentadiene	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachloroethane	<0.47	<0.47	<0.49	<0.49	<0.49
Indeno(1,2,3-cd)pyrene	<0.05	<0.05	<0.05	<0.05	<0.05
Isophorone	<4.7	<4.7	<4.9	<4.9	<4.9
Nitrobenzene	<0.09	<0.09	<0.10	<0.10	<0.10
N-Nitrosodimethylamine	<4.7	<4.7	<4.9	<4.9	<4.9
N-Nitroso-di-N-propylamine	<4.7	<4.7	<4.9	<4.9	<4.9

Table A-2. Current surface water data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-01	SW-DUP-01	SW-02	SW-03	SW-04
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17
Lab Sample ID	BZ40757	BZ40761	BZ40758	BZ40759	BZ40760
N-Nitrosodiphenylamine	<4.7	<4.7	<4.9	<4.9	<4.9
Pentachloronitrobenzene	<0.09	<0.09	<0.10	<0.10	<0.10
Pentachlorophenol	<0.75	<0.75	<0.78	<0.78	<0.79
Phenanthrene	<0.05	<0.05	<0.05	<0.05	<0.05
Phenol	<0.94	<0.94	<0.97	<0.98	<0.99
Pyrene	<0.05	<0.05	<0.05	<0.05	<0.05
Pyridine	<0.47	<0.47	<0.49	<0.49	<0.49
Naphthalene	<1.0	<1.0	<1.0	<0.10	<0.10
Voaltile Organic Compounds (ug/L)					
Tetrachloroethane, 1,1,1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethane, 1,1,1-	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethane, 1,1,2,2-	<0.50	<0.50	<0.50	<0.50	<0.50
Trichlorotrifluoroethane, 1,1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethane, 1,1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloroethane, 1,1-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloroethene, 1,1-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloropropene, 1,1-	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorobenzene, 1,2,3-	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloropropane, 1,2,3-	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorobenzene,1,2,4-	<4.7	<4.7	<1.0	<1.0	<1.0
Trimethylbenzene, 1,2,4-	<1.0	<1.0	<1.0	<1.0	<1.0
Dibromo-3-chloropropane,1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorobenzene, 1,2- (o-DCB)	<1.0	<1.0	<2.4	<1.0	<2.5
Dichloroethane, 1,2-	<0.60	<0.60	<0.60	<0.60	<0.60
Dichloropropane, 1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Trimethylbenzene, 1,3,5-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorobenzene, 1,3-(m-DCB)	<2.3	<2.3	<1.0	<2.5	<1.0
Dichloropropane, 1,3-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorobenzene, 1,4- (p-DCB)	<1.0	<1.0	<2.4	<2.5	<2.5
Dichloropropane, 2,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorotoluene, 2-	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl butyl ketone (2-Hexanone)	<5.0	<5.0	<5.0	<5.0	<5.0
Isopropyltoluene, 2- (o-Cymene)	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorotoluene, 4-	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropyltoluene, 4- (p-Cymene)	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	<5.0	<5.0	<5.0	<5.0	<5.0
Acetone	<25	<25	<25	<25	<25
Acrylonitrile	<5.0	<5.0	<5.0	<5.0	<5.0
Benzene	<0.70	<0.70	<0.70	<0.70	<0.70
Bromobenzene	<1.0	<1.0	<1.0	<1.0	<1.0
Bromochloromethane	<1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	<0.50	<0.50	<0.50	<0.50	<0.50
Bromoform	<1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	<1.0	<1.0	<1.0	<1.0	<1.0
Butylbenzene, n-	<1.0	<1.0	<1.0	<1.0	<1.0
Butylbenzene, sec-	<1.0	<1.0	<1.0	<1.0	<1.0
Butylbenzene, tert-	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon disulfide	<5.0	<5.0	<5.0	<5.0	<5.0

Table A-2. Current surface water data for the Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-01	SW-DUP-01	SW-02	SW-03	SW-04
Sample Date	11/13/17	11/13/17	11/13/17	11/13/17	11/13/17
Lab Sample ID	BZ40757	BZ40761	BZ40758	BZ40759	BZ40760
Carbon tetrachloride	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	<1.0	<1.0	<1.0	<1.0	<1.0
Chloromethane	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloroethene, cis-1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloropropene, cis-1,3-	<0.40	<0.40	<0.40	<0.40	<0.40
Dibromochloromethane	<0.50	<0.50	<0.50	<0.50	<0.50
Dibromomethane	<1.0	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylene Dibromide (EDB)	<1.0	<1.0	<1.0	<1.0	<1.0
Hexachlorobutadiene	<0.40	<0.40	<0.49	<0.49	<0.49
Isopropylbenzene (cumene)	<1.0	<1.0	<1.0	<1.0	<1.0
Xylene, m,p-	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl ethyl ketone	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl Tert-Butyl Ether (MTBE)	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride (Dichloromethane)	<1.0	<1.0	<1.0	<1.0	<1.0
Propylbenzene, n-	<1.0	<1.0	<1.0	<1.0	<1.0
Xylene, o-	<1.0	<1.0	<1.0	<1.0	<1.0
Styrene	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethylene (PCE)	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrahydrofuran	<2.5	<2.5	<2.5	<2.5	<2.5
Toluene	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloroethene, trans-1,2-	<1.0	<1.0	<1.0	<1.0	<1.0
Dichloropropene, trans-1,3-	<0.40	<0.40	<0.40	<0.40	<0.40
Dichloro-2-butene, trans-1,4-	<5.0	<5.0	<5.0	<5.0	<5.0
Trichloroethylene (TCE)	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	<1.0	<1.0	<1.0	<1.0	<1.0
Xylene (Total)	<1.0	<1.0	<1.0	<1.0	<1.0

Notes:
ug/L - microgram per liter
mg/L - milligram per liter

Table A-3. Current sediment data for the Hockanum River upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SED-101	SED-102	SED-103	SED-104	SED-105
Sample Date	10/21/20	10/21/20	10/21/20	10/21/20	10/21/20
Lab Sample ID	460-221363-1	460-221363-2	460-221363-3	460-221363-4	460-221363-5
Hydrocarbon (mg/Kg)					
CT ETPH	850	350	660	890	480
Metals (mg/Kg)					
Antimony	<1.2	<1.2	<1.2	<1.2	<1.1
Arsenic	<1.2	<1.2	1.2	1.4	<1.1
Barium	26	20	26	24	26
Beryllium	<0.50	<0.49	<0.48	<0.47	<0.46
Cadmium	<1.2	<1.2	<1.2	<1.2	<1.1
Chromium (Total)	7.8	18	8.2	7.6	8.2
Copper	16	19	24	20	16
Lead	26	57	54	26	33
Mercury	<0.020	<0.019	<0.020	<0.020	<0.020
Nickel	6.5	7.2	7	6.8	7.6
Selenium	<1.6	<1.5	<1.5	<1.5	<1.4
Silver	<1.2	<1.2	<1.2	<1.2	<1.1
Thallium	<0.50	<0.49	<0.48	<0.47	<0.46
Vanadium	18	27	35	23	22
Zinc	56	150	75	43	54
Polycyclic Aromatic Hydrocarbons (ug/Kg)					
Methylnaphthalene, 2-	47	56	44	25	91
Acenaphthene	120	130	150	60	83
Acenaphthylene	890	570	450	260	410
Anthracene	790	730	660	320	470
Benzo(a)anthracene	2300	1600	1600	890	1400
Benzo(a)pyrene	2100	1400	1300	760	1100
Benzo(b)fluoranthene	2500	1600	1500	940	1300
Benzo(g,h,i)perylene	1700	1200	950	530	780
Benzo(k)fluoranthene	810	410	580	330	490
Chrysene	2300	1500	1500	870	1200
Dibenz(a,h)anthracene	510	370	360	170	250
Fluoranthene	5100	3900	3700	2000	2800
Fluorene	250	340	250	120	160
Indeno(1,2,3-cd)pyrene	1500	1000	880	510	710
Phenanthrene	2600	3300	2600	1300	1700
Pyrene	4700	3800	3300	1900	2500
Naphthalene	65	96	47	34	430
Other (mg/Kg)					
Carbon (Total Organic)	7,400	<120	2,100	1,300	3,100

Notes:
ug/Kg - microgram per kilogram
mg/Kg - milligram per kilogram

Table A-4. Current surface water data for the Hockanum River upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-100	SW-101
Sample Date	10/21/2020	10/21/2020
Lab Sample ID	460-221363-6	460-221363-7
Hydrocarbon (mg/L)		
CT ETPH	<0.075	<0.075
Metals (ug/L)		
Antimony (Total)	**<2**	**<2**
Antimony (Dissolved)	<2	<2
Arsenic (Total)	<2	<2
Arsenic (Dissolved)	<2	<2
Barium (Total)	51	58
Barium (Dissolved)	54	53
Beryllium (Total)	<0.8	<0.8
Beryllium (Dissolved)	<0.8	<0.8
Cadmium (Total)	<2	<2
Cadmium (Dissolved	<2	<2
Chromium (Total)	<4	<4
Chromium (Dissolved)	<4	<4
Copper (Total)	<4	<4
Copper (Dissolved)	<4	<4
Lead (Total)	<1.2	<1.2
Lead (Dissolved)	<1.2	<1.2
Mercury (Total)	<0.20	<0.20
Mercury (Dissolved)	<0.20	<0.20
Nickel (Total)	<4	<4
Nickel (Dissolved)	<4	<4
Selenium (Total)	<2.5	<2.5
Selenium (Dissolved)	<2.5	<2.5
Silver (Total)	<2	<2
Silver (Dissolved)	<2	<2
Thallium (Total)	<0.8	<0.8
Thallium (Dissolved)	<0.8	<0.8
Vanadium (Total)	<4	<4
Vanadium (Dissolved)	<4	<4
Zinc (Total)	<16	<16
Zinc (Dissolved)	<16	<16
Polycyclic Aromatic Hydrocarbons (ug/L)		
Methylnaphthalene, 2-	<0.05	<0.05
Acenaphthene	<0.05	<0.05

Table A-4. Current surface water data for the Hockanum River upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Station Name	SW-100	SW-101
Sample Date	10/21/2020	10/21/2020
Lab Sample ID	460-221363-6	460-221363-7
Acenaphthylene	<0.05	<0.05
Anthracene	<0.05	<0.05
Benzo(a)anthracene	<0.05	<0.05
Benzo(a)pyrene	<0.05	<0.05
Benzo(b)fluoranthene	<0.05	<0.05
Benzo(g,h,i)perylene	<0.05	<0.05
Benzo(k)fluoranthene	<0.05	<0.05
Chrysene	<0.05	<0.05
Dibenz(a,h)anthracene	<0.05	<0.05
Fluoranthene	<0.05	<0.05
Fluorene	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	<0.05	<0.05
Phenanthrene	<0.05	<0.05
Pyrene	<0.05	<0.05
Naphthalene	<0.2	<0.2

Notes:
ug/L - microgram per liter
mg/L - milligram per liter

Appendix B

Supporting Tables for the Chemicals of Potential Ecological Concern Selection

Table B-1. Selection of chemicals of potential ecological concern-sediment, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)	Sediment SL (mg/kg)	Historical evidence (Y/N)	CoPEC Determination
CT ETPH	Hydrocarbon	B	11	9	81.8	1400	290	NR	Y	CoPEC:Detected and no SL, but is a BCC
Antimony	Metal		11	0	0	NA	22	0.16	Y	ND CoPEC: MRL>SL and historical use
Arsenic	Metal	B	11	8	72.7	7.3	0.85	9.79	Y	CoPEC: MDC<SL and is a BCC
Barium	Metal		11	11	100	324	NA	0.7	Y	CoPEC:MDC>SL
Beryllium	Metal		11	0	0	NA	1.8	NR	Y	Not a CoPEC: Not detected and No SL
Cadmium	Metal	B	11	4	36.4	2.9	1.4	0.99	Y	CoPEC:MDC>SL
Chromium (Total)	Metal		11	11	100	66.4	NA	43.4	Y	CoPEC:MDC>SL
Copper	Metal	B	14	14	100	2190	NA	31.6	Y	CoPEC:MDC>SL
Lead	Metal	B	11	11	100	267	NA	35.8	Y	CoPEC:MDC>SL
Mercury	Metal	B	11	3	27.3	0.21	0.03	0.18	Y	CoPEC:MDC>SL
Nickel	Metal	B	11	11	100	41.6	NA	22.7	Y	CoPEC:MDC>SL
Selenium	Metal	B	11	0	0	NA	8.9	2	Y	ND CoPEC: MRL>SL and historical use
Silver	Metal	B	11	0	0	NA	2.2	1	Y	ND CoPEC: MRL>SL and historical use
Thallium	Metal		11	0	0	NA	20	NR	Y	Not a CoPEC: Not detected and No SL
Vanadium	Metal		11	11	100	109	NA	50	Y	CoPEC:MDC>SL
Zinc	Metal	B	11	11	100	606	NA	121	Y	CoPEC:MDC>SL
Cyanide (Total)	Inorganic		6	0	0	NA	0.61	0.1	Y	ND CoPEC: MRL>SL and historical use
Aroclor-1016	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1221	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1232	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1242	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1248	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1254	PCBs	B	11	0	0	NA	0.44	0.06	N	Not a CoPEC: MRL>SL and no historical use
Aroclor-1260	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1262	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
Aroclor-1268	PCBs	B	11	0	0	NA	0.44	NR	N	Not a CoPEC: Not detected and No SL
PCBs (Total)	PCBs	B	11	0	0	NA	0.44	0.0598	N	Not a CoPEC: MRL>SL and no historical use
Tetrachlorobenzene, 1,2,4,5-	SVOC	B	9	0	0	NA	3	1.09	Y	ND CoPEC: MRL>SL and historical use
Diphenylhydrazine, 1,2-	SVOC		9	0	0	NA	4.3	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorophenol, 2,4,5-	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorophenol, 2,4,6-	SVOC		9	0	0	NA	3	0.213	Y	ND CoPEC: MRL>SL and historical use
Dichlorophenol, 2,4-	SVOC		9	0	0	NA	3	0.117	Y	ND CoPEC: MRL>SL and historical use
Dimethylphenol, 2,4-	SVOC		9	0	0	NA	3	0.029	Y	ND CoPEC: MRL>SL and historical use
Dinitrophenol, 2,4-	SVOC		9	0	0	NA	4.3	0.00621	Y	ND CoPEC: MRL>SL and historical use
Dinitrotoluene, 2,4-	SVOC		9	0	0	NA	3	0.0416	Y	ND CoPEC: MRL>SL and historical use
Dinitrotoluene, 2,6-	SVOC		9	0	0	NA	3	0.0398	Y	ND CoPEC: MRL>SL and historical use
Chloronaphthalene, 2-	SVOC		9	0	0	NA	3	0.417	Y	ND CoPEC: MRL>SL and historical use
Chlorophenol, 2-	SVOC		9	0	0	NA	3	0.0312	Y	ND CoPEC: MRL>SL and historical use
Methylnaphthalene, 2-	PAH		11	2	18.2	0.79	3	0.0202	Y	CoPEC:MDC>SL
Methylphenol, 2-	SVOC		9	0	0	NA	3	0.0554	Y	ND CoPEC: MRL>SL and historical use
Nitroaniline, 2-	SVOC		9	0	0	NA	4.3	NR	Y	Not a CoPEC: Not detected and No SL
Nitrophenol, 2-	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
Methylphenol, 3&4 (Cresol, m&p-)	SVOC		9	0	0	NA	4.3	0.67	Y	ND CoPEC: MRL>SL and historical use
Dichlorobenzidine, 3,3-	SVOC		9	0	0	NA	3	0.127	Y	ND CoPEC: MRL>SL and historical use
Nitroaniline, 3-	SVOC		9	0	0	NA	4.3	NR	Y	Not a CoPEC: Not detected and No SL
Dinitro-2-methylphenol, 4,6-	SVOC		9	0	0	NA	4.3	0.104	Y	ND CoPEC: MRL>SL and historical use
Bromophenyl Phenyl Ether, 4-	SVOC	B	9	0	0	NA	4.3	1.23	Y	ND CoPEC: MRL>SL and historical use
Chloro-3-methylphenol, 4-	SVOC		9	0	0	NA	3	0.388	Y	ND CoPEC: MRL>SL and historical use
Chloroanilne, p- (4-Chloroaniline)	SVOC		9	0	0	NA	3	0.146	Y	ND CoPEC: MRL>SL and historical use
Chlorophenyl-phenylether, 4-	SVOC	B	9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL

Table B-1. Selection of chemicals of potential ecological concern-sediment, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)	Sediment SL (mg/kg)	Historical evidence (Y/N)	CoPEC Determination
Nitroaniline, 4-	SVOC		9	0	0	NA	6.9	NR	Y	Not a CoPEC: Not detected and No SL
Nitrophenol, 4-	SVOC		9	0	0	NA	3	0.0133	Y	ND CoPEC: MRL>SL and historical use
Acenaphthene	PAH	B	11	3	27.3	1.3	3	0.0067	Y	CoPEC:MDC>SL
Acenaphthylene	PAH	B	11	8	72.7	1.4	3	0.0059	Y	CoPEC:MDC>SL
Acetophenone	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
Aniline	SVOC		9	0	0	NA	4.3	0.00031	Y	ND CoPEC: MRL>SL and historical use
Anthracene	PAH	B	11	7	63.6	3.3	3	0.0572	Y	CoPEC:MDC>SL
Benzo(a)anthracene	PAH	B	11	10	90.9	7.2	1.5	0.108	Y	CoPEC:MDC>SL
Benzidine	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
Benzo(a)pyrene	PAH	B	11	11	100	6.1	NA	0.15	Y	CoPEC:MDC>SL
Benzo(b)fluoranthene	PAH	B	11	10	90.9	5.3	3	10.4	Y	CoPEC: MDC<SL and is a BCC
Benzo(g,h,i)perylene	PAH	B	11	7	63.6	3.3	3	0.17	Y	CoPEC:MDC>SL
Benzo(k)fluoranthene	PAH	B	11	10	90.9	5.4	1.5	0.0272	Y	CoPEC:MDC>SL
Benzoic acid	SVOC		9	0	0	NA	8.6	0.65	Y	ND CoPEC: MRL>SL and historical use
bis(2-Chloroethoxy)methane	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
bis(2-Chloroethyl)ether	SVOC		9	0	0	NA	4.3	3.52	Y	ND CoPEC: MRL>SL and historical use
bis(2-Chloroisopropyl)ether	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
bis(2-Ethylhexyl)phthalate	SVOC		9	0	0	NA	3	0.18	Y	ND CoPEC: MRL>SL and historical use
Butyl benzyl phthalate	SVOC		9	0	0	NA	3	11	Y	Not a CoPEC: Not detected and MRL<SL
Carbazole	SVOC		9	2	22.2	1.5	4.3	NR	Y	Not a CoPEC: Detected and no SL, but is not a BCC
Chrysene	PAH	B	11	11	100.0	7.6	NA	0.166	Y	CoPEC:MDC>SL
Dibenz(a,h)anthracene	PAH	B	11	4	36.4	0.80	3	0.033	Y	CoPEC:MDC>SL
Dibenzofuran	SVOC		9	1	11.1	1.1	3	2	Y	Not a CoPEC: MDC<SL and is not a BCC
Diethylphthalate	SVOC		9	0	0	NA	3	0.63	Y	ND CoPEC: MRL>SL and historical use
Dimethyl phthalate	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
Di-N-Butyl Phthalate	SVOC		9	0	0	NA	8.6	11	Y	Not a CoPEC: Not detected and MRL<SL
Di-N-Octyl Phthalate	SVOC		9	0	0	NA	3	40.6	Y	Not a CoPEC: Not detected and MRL<SL
Fluoranthene	PAH	B	11	11	100	19	NA	0.423	Y	CoPEC:MDC>SL
Fluorene	PAH	B	11	6	54.5	2.2	3	0.0774	Y	CoPEC:MDC>SL
Hexachlorobenzene	SVOC	B	9	0	0	NA	3	0.02	Y	ND CoPEC: MRL>SL and historical use
Hexachlorocyclopentadiene	SVOC	B	9	0	0	NA	3	0.901	Y	ND CoPEC: MRL>SL and historical use
Hexachloroethane	SVOC	B	9	0	0	NA	3	1	Y	ND CoPEC: MRL>SL and historical use
Indeno(1,2,3-cd)pyrene	PAH	B	11	8	72.7	3.9	3	0.0173	Y	CoPEC:MDC>SL
Isophorone	SVOC		9	0	0	NA	3	0.432	Y	ND CoPEC: MRL>SL and historical use
Nitrobenzene	SVOC		9	0	0	NA	3	0.145	Y	ND CoPEC: MRL>SL and historical use
N-Nitrosodimethylamine	SVOC		9	0	0	NA	4.3	NR	Y	Not a CoPEC: Not detected and No SL
N-Nitroso-di-N-propylamine	SVOC		9	0	0	NA	3	NR	Y	Not a CoPEC: Not detected and No SL
N-Nitrosodiphenylamine	SVOC		9	0	0	NA	4.3	2.68	Y	ND CoPEC: MRL>SL and historical use
Pentachloronitrobenzene	SVOC		9	0	0	NA	4.3	NR	Y	Not a CoPEC: Not detected and No SL
Pentachlorophenol	SVOC		9	0	0	NA	4.3	0.504	Y	ND CoPEC: MRL>SL and historical use
Phenanthrene	PAH	B	11	10	90.9	19	1.5	0.204	Y	CoPEC:MDC>SL
Phenol	SVOC	B	9	0	0	NA	3	0.42	Y	ND CoPEC: MRL>SL and historical use
Pyrene	PAH	B	11	11	100	16	NA	0.195	Y	CoPEC:MDC>SL
Pyridine	SVOC		9	0	0	NA	4.3	0.106	Y	ND CoPEC: MRL>SL and historical use
Naphthalene	PAH		11	2	18.2	0.77	3	0.176	Y	CoPEC:MDC>SL
Trichlorobenzene,1,2,4-	SVOC		9	0	0	NA	3	9.2	Y	Not a CoPEC: Not detected and MRL<SL
Dichlorobenzene, 1,2- (o-DCB)	SVOC	B	9	0	0	NA	3	0.34	Y	ND CoPEC: MRL>SL and historical use
Dichlorobenzene, 1,3-(m-DCB)	SVOC	B	9	0	0	NA	3	1.7	Y	ND CoPEC: MRL>SL and historical use
Dichlorobenzene, 1,4- (p-DCB)	SVOC	B	9	0	0	NA	3	0.35	Y	ND CoPEC: MRL>SL and historical use
Hexachlorobutadiene	SVOC	B	9	0	0	NA	3	0.0265	Y	ND CoPEC: MRL>SL and historical use

Table B-1. Selection of chemicals of potential ecological concern-sediment, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)	Sediment SL (mg/kg)	Historical evidence (Y/N)	CoPEC Determination
Naphthalene	VOC		9	0	0	NA	0.033	0.176	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethane, 1,1,1,2-	VOC	B	9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethane, 1,1,1-	VOC		9	0	0	NA	0.033	0.17	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethane, 1,1,2,2-	VOC	B	9	0	0	NA	0.02	0.94	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorotrifluoroethane, 1,1,2-	VOC		9	0	0	NA	0.065	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethane, 1,1,2-	VOC		9	0	0	NA	0.033	1.24	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethane, 1,1-	VOC		9	0	0	NA	0.033	0.000575	Y	ND CoPEC: MRL>SL and historical use
Dichloroethene, 1,1-	VOC		9	0	0	NA	0.033	0.031	Y	ND CoPEC: MRL>SL and historical use
Dichloropropene, 1,1-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorobenzene, 1,2,3-	VOC		9	0	0	NA	0.033	0.858	Y	Not a CoPEC: Not detected and MRL<SL
Trichloropropane, 1,2,3-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorobenzene,1,2,4-	VOC	B	9	0	0	NA	0.033	9.2	Y	Not a CoPEC: Not detected and MRL<SL
Trimethylbenzene, 1,2,4-	VOC	B	9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dibromo-3-chloropropane,1,2-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorobenzene, 1,2- (o-DCB)	VOC	B	9	0	0	NA	0.033	0.34	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethane, 1,2-	VOC		9	0	0	NA	0.033	0.26	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 1,2-	VOC		9	0	0	NA	0.033	0.333	Y	Not a CoPEC: Not detected and MRL<SL
Trimethylbenzene, 1,3,5-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorobenzene, 1,3-(m-DCB)	VOC	B	9	0	0	NA	0.033	1.7	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 1,3-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorobenzene, 1,4- (p-DCB)	VOC	B	9	0	0	NA	0.033	0.35	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 2,2-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Chlorotoluene, 2-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Methyl butyl ketone (2-Hexanone)	VOC		9	0	0	NA	0.16	NR	Y	Not a CoPEC: Not detected and No SL
Isopropyltoluene, 2- (o-Cymene)	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Chlorotoluene, 4-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Isopropyltoluene, 4- (p-Cymene)	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	VOC		9	0	0	NA	0.16	NR	Y	Not a CoPEC: Not detected and No SL
Acetone	VOC		9	0	0	NA	1.6	0.0099	Y	ND CoPEC: MRL>SL and historical use
Acrylonitrile	VOC		9	0	0	NA	0.033	0.0012	Y	ND CoPEC: MRL>SL and historical use
Benzene	VOC		9	0	0	NA	0.033	0.142	Y	Not a CoPEC: Not detected and MRL<SL
Bromobenzene	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Bromochloromethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Bromodichloromethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Bromoform	VOC		9	0	0	NA	0.033	0.654	Y	Not a CoPEC: Not detected and MRL<SL
Bromomethane	VOC		9	0	0	NA	0.033	0.00137	Y	ND CoPEC: MRL>SL and historical use
Butylbenzene, n-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Butylbenzene, sec-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Butylbenzene, tert-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Carbon disulfide	VOC		9	0	0	NA	0.033	0.000851	Y	ND CoPEC: MRL>SL and historical use
Carbon tetrachloride	VOC		9	0	0	NA	0.033	0.0642	Y	Not a CoPEC: Not detected and MRL<SL
Chlorobenzene	VOC		9	0	0	NA	0.033	0.82	Y	Not a CoPEC: Not detected and MRL<SL
Chloroethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Chloroform	VOC		9	0	0	NA	0.033	0.121	Y	Not a CoPEC: Not detected and MRL<SL
Chloromethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichloroethene, cis-1,2-	VOC	B	9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichloropropene, cis-1,3-	VOC		9	0	0	NA	0.033	5.09E-05	Y	ND CoPEC: MRL>SL and historical use
Dibromochloromethane	VOC		9	0	0	NA	0.02	NR	Y	Not a CoPEC: Not detected and No SL
Dibromomethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorodifluoromethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL

Table B-1. Selection of chemicals of potential ecological concern-sediment, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (mg/kg)	Maximum Reporting Limit (mg/kg)	Sediment SL (mg/kg)	Historical evidence (Y/N)	CoPEC Determination
Ethylbenzene	VOC		9	0	0	NA	0.033	3.6	Y	Not a CoPEC: Not detected and MRL<SL
Ethylene Dibromide (EDB)	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Hexachlorobutadiene	VOC	B	9	0	0	NA	0.033	0.0265	Y	ND CoPEC: MRL>SL and historical use
Isopropylbenzene (cumene)	VOC		9	0	0	NA	0.033	0.086	Y	Not a CoPEC: Not detected and MRL<SL
Xylene, m,p-	VOC		9	0	0	NA	0.033	0.0252	Y	ND CoPEC: MRL>SL and historical use
Methyl ethyl ketone	VOC		9	0	0	NA	0.2	0.0424	Y	ND CoPEC: MRL>SL and historical use
Methyl Tert-Butyl Ether (MTBE)	VOC		9	0	0	NA	0.065	NR	Y	Not a CoPEC: Not detected and No SL
Methylene Chloride (Dichloromethane)	VOC		9	0	0	NA	0.065	0.159	Y	Not a CoPEC: Not detected and MRL<SL
Propylbenzene, n-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Xylene, o-	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Styrene	VOC		9	0	0	NA	0.033	0.559	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethylene (PCE)	VOC		9	0	0	NA	0.033	0.53	Y	Not a CoPEC: Not detected and MRL<SL
Tetrahydrofuran	VOC		9	0	0	NA	0.065	NR	Y	Not a CoPEC: Not detected and No SL
Toluene	VOC		9	1	11.1	0.24	0.0065	0.67	Y	Not a CoPEC: MDC<SL and is not a BCC
Dichloroethene, trans-1,2-	VOC		9	0	0	NA	0.033	1.05	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropene, trans-1,3-	VOC		9	0	0	NA	0.033	5.09E-05	Y	ND CoPEC: MRL>SL and historical use
Dichloro-2-butene, trans-1,4-	VOC		9	0	0	NA	0.065	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethylene (TCE)	VOC		9	0	0	NA	0.033	1.6	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorofluoromethane	VOC		9	0	0	NA	0.033	NR	Y	Not a CoPEC: Not detected and No SL
Vinyl Chloride	VOC		9	0	0	NA	0.033	0.202	Y	Not a CoPEC: Not detected and MRL<SL
Xylene (Total)	VOC		9	0	0	NA	0.033	0.433	Y	Not a CoPEC: Not detected and MRL<SL

Notes:
BCC - bioaccumulative chemical compound
CoPEC - chemical of potential ecological concern
MDC - maximum detected concentration
mg/kg - milligram per kilogram
MRL - maximum reporting limit
NA - not available
ND - not detected
NR - not reported
PAHs - polycyclic aromatic hydrocarbons
PCBs - polychlorinated biphenyls
SL - screening level
SVOC - semi-volatile organic compound
VOC - volatile organic compound

Table B-2. Selection of chemicals of potential ecological concern-surface water, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (ug/L)	Maximum Reporting Limit (ug/L)	Surface Water SL (ug/L)	Historical evidence (Y/N)	CoPEC Determination
CT ETPH	Hydrocarbon	B	4	0	0	NA	70	NR	Y	Not a CoPEC: Not detected and No SL
Antimony (Total)	Metal		4	0	0	NA	5	30	Y	Not a CoPEC: Not detected and MRL<SL
Antimony (Dissolved)	Metal		4	0	0	NA	5	30	Y	Not a CoPEC: Not detected and MRL<SL
Arsenic (Total)	Metal	B	4	0	0	NA	4	150	Y	Not a CoPEC: Not detected and MRL<SL
Arsenic (Dissolved)	Metal	B	4	0	0	NA	4	150	Y	Not a CoPEC: Not detected and MRL<SL
Barium (Total)	Metal		4	4	100	53	NA	3.9	Y	CoPEC:MDC>SL
Barium (Dissolved)	Metal		4	4	100	56	NA	3.9	Y	CoPEC:MDC>SL
Beryllium (Total)	Metal		4	0	0	NA	1	0.66	Y	ND CoPEC: MRL>SL and historical use
Beryllium (Dissolved)	Metal		4	0	0	NA	1	0.66	Y	ND CoPEC: MRL>SL and historical use
Cadmium (Total)	Metal	B	4	0	0	NA	1	0.125	Y	ND CoPEC: MRL>SL and historical use
Cadmium (Dissolved)	Metal	B	4	0	0	NA	1	0.125	Y	ND CoPEC: MRL>SL and historical use
Chromium (Total)	Metal		4	0	0	NA	1	11	Y	Not a CoPEC: Not detected and MRL<SL
Chromium (Dissolved)	Metal		4	2	50	1	1	11	Y	Not a CoPEC: MDC<SL and is not a BCC
Copper (Total)	Metal	B	4	0	0	NA	5	4.8	Y	ND CoPEC: MRL>SL and historical use
Copper (Dissolved)	Metal	B	4	0	0	NA	5	4.8	Y	ND CoPEC: MRL>SL and historical use
Lead (Total)	Metal	B	4	0	0	NA	2	1.2	Y	ND CoPEC: MRL>SL and historical use
Lead (Dissolved)	Metal	B	4	0	0	NA	2	1.2	Y	ND CoPEC: MRL>SL and historical use
Mercury (Total)	Metal	B	4	0	0	NA	0.2	0.77	Y	Not a CoPEC: Not detected and MRL<SL
Mercury (Dissolved)	Metal	B	4	0	0	NA	0.2	0.77	Y	Not a CoPEC: Not detected and MRL<SL
Nickel (Total)	Metal	B	4	0	0	NA	1	28.9	Y	Not a CoPEC: Not detected and MRL<SL
Nickel (Dissolved)	Metal	B	4	0	0	NA	1	28.9	Y	Not a CoPEC: Not detected and MRL<SL
Selenium (Total)	Metal	B	4	0	0	NA	10	5	Y	ND CoPEC: MRL>SL and historical use
Selenium (Dissolved)	Metal	B	4	0	0	NA	11	5	Y	ND CoPEC: MRL>SL and historical use
Silver (Total)	Metal	B	4	0	0	NA	1	0.36	Y	ND CoPEC: MRL>SL and historical use
Silver (Dissolved)	Metal	B	4	0	0	NA	1	0.36	Y	ND CoPEC: MRL>SL and historical use
Thallium (Total)	Metal		4	0	0	NA	1	12	Y	Not a CoPEC: Not detected and MRL<SL
Thallium (Dissolved)	Metal		4	0	0	NA	2	12	Y	Not a CoPEC: Not detected and MRL<SL
Vanadium (Total)	Metal		4	0	0	NA	2	19	Y	Not a CoPEC: Not detected and MRL<SL
Vanadium (Dissolved)	Metal		4	0	0	NA	2	19	Y	Not a CoPEC: Not detected and MRL<SL
Zinc (Total)	Metal	B	4	1	25	2.5	2	65	Y	CoPEC: MDC<SL and is a BCC
Zinc (Dissolved)	Metal	B	4	4	100	6	NA	65	Y	CoPEC: MDC<SL and is a BCC
Cyanide (Total)	Inorganic		4	0	0	NA	10	5.2	Y	ND CoPEC: MRL>SL and historical use
Tetrachlorobenzene, 1,2,4,5-	SVOC	B	4	0	0	NA	0.49	50	Y	Not a CoPEC: Not detected and MRL<SL
Diphenylhydrazine, 1,2-	SVOC		4	0	0	NA	4.9	27	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorophenol, 2,4,5-	SVOC		4	0	0	NA	0.99	63	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorophenol, 2,4,6-	SVOC		4	0	0	NA	0.99	4.9	Y	Not a CoPEC: Not detected and MRL<SL
Dichlorophenol, 2,4-	SVOC		4	0	0	NA	0.99	11	Y	Not a CoPEC: Not detected and MRL<SL
Dimethylphenol, 2,4-	SVOC		4	0	0	NA	0.99	21.2	Y	Not a CoPEC: Not detected and MRL<SL
Dinitrophenol, 2,4-	SVOC		4	0	0	NA	0.99	19	Y	Not a CoPEC: Not detected and MRL<SL
Dinitrotoluene, 2,4-	SVOC		4	0	0	NA	4.9	44	Y	Not a CoPEC: Not detected and MRL<SL
Dinitrotoluene, 2,6-	SVOC		4	0	0	NA	4.9	81	Y	Not a CoPEC: Not detected and MRL<SL
Chloronaphthalene, 2-	SVOC		4	0	0	NA	4.9	0.396	Y	ND CoPEC: MRL>SL and historical use
Chlorophenol, 2-	SVOC		4	0	0	NA	0.99	24	Y	Not a CoPEC: Not detected and MRL<SL
Methylnaphthalene, 2-	PAH		4	0	0	NA	0.99	4.7	Y	Not a CoPEC: Not detected and MRL<SL
Methylphenol, 2-	SVOC		4	0	0	NA	0.99	13	Y	Not a CoPEC: Not detected and MRL<SL
Nitroaniline, 2-	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
Nitrophenol, 2-	SVOC		4	0	0	NA	0.99	1920	Y	Not a CoPEC: Not detected and MRL<SL
Methylphenol, 3&4 (Cresol, m&p-)	SVOC		4	0	0	NA	9.9	543	Y	Not a CoPEC: Not detected and MRL<SL
Dichlorobenzidine, 3,3-	SVOC		4	0	0	NA	4.9	4.5	Y	ND CoPEC: MRL>SL and historical use
Nitroaniline, 3-	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
Dinitro-2-methylphenol, 4,6-	SVOC		4	0	0	NA	0.99	2.3	Y	Not a CoPEC: Not detected and MRL<SL
Bromophenyl Phenyl Ether, 4-	SVOC	B	4	0	0	NA	4.9	1.5	Y	ND CoPEC: MRL>SL and historical use
Chloro-3-methylphenol, 4-	SVOC		4	0	0	NA	0.99	0.3	Y	ND CoPEC: MRL>SL and historical use
Chloroanilne, p- (4-Chloroaniline)	SVOC		4	0	0	NA	4.9	232	Y	Not a CoPEC: Not detected and MRL<SL
Chlorophenyl-phenylether, 4-	SVOC	B	4	0	0	NA	0.99	NR	Y	Not a CoPEC: Not detected and No SL
Nitroaniline, 4-	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL

Table B-2. Selection of chemicals of potential ecological concern-surface water, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (ug/L)	Maximum Reporting Limit (ug/L)	Surface Water SL (ug/L)	Historical evidence (Y/N)	CoPEC Determination
Nitrophenol, 4-	SVOC		4	0	0	NA	0.99	60	Y	Not a CoPEC: Not detected and MRL<SL
Acenaphthene	PAH	B	4	0	0	NA	0.05	23	Y	Not a CoPEC: Not detected and MRL<SL
Acenaphthylene	PAH	B	4	0	0	NA	0.05	4840	Y	Not a CoPEC: Not detected and MRL<SL
Acetophenone	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
Aniline	SVOC		4	0	0	NA	4.9	2.2	Y	ND CoPEC: MRL>SL and historical use
Anthracene	PAH	B	4	0	0	NA	0.05	0.73	Y	Not a CoPEC: Not detected and MRL<SL
Benzo(a)anthracene	PAH	B	4	0	0	NA	0.05	0.027	Y	ND CoPEC: MRL>SL and historical use
Benzidine	SVOC		4	0	0	NA	4.9	3.9	Y	ND CoPEC: MRL>SL and historical use
Benzo(a)pyrene	PAH	B	4	0	0	NA	0.05	0.014	Y	ND CoPEC: MRL>SL and historical use
Benzo(b)fluoranthene	PAH	B	4	0	0	NA	0.05	9.07	Y	Not a CoPEC: Not detected and MRL<SL
Benzo(g,h,i)perylene	PAH	B	4	0	0	NA	0.2	7.64	Y	Not a CoPEC: Not detected and MRL<SL
Benzo(k)fluoranthene	PAH	B	4	0	0	NA	0.05	NR	Y	Not a CoPEC: Not detected and No SL
Benzoic acid	SVOC		4	0	0	NA	49	42	Y	ND CoPEC: MRL>SL and historical use
bis(2-Chloroethoxy)methane	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
bis(2-Chloroethyl)ether	SVOC		4	0	0	NA	0.99	1900	Y	Not a CoPEC: Not detected and MRL<SL
bis(2-Chloroisopropyl)ether	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
bis(2-Ethylhexyl)phthalate	SVOC		4	0	0	NA	0.49	32	Y	Not a CoPEC: Not detected and MRL<SL
Butyl benzyl phthalate	SVOC		4	0	0	NA	4.9	19	Y	Not a CoPEC: Not detected and MRL<SL
Carbazole	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
Chrysene	PAH	B	4	0	0	NA	0.05	NR	Y	Not a CoPEC: Not detected and No SL
Dibenz(a,h)anthracene	PAH	B	4	0	0	NA	0.01	NR	Y	Not a CoPEC: Not detected and No SL
Dibenzofuran	SVOC		4	0	0	NA	0.05	3.7	Y	Not a CoPEC: Not detected and MRL<SL
Diethylphthalate	SVOC		4	0	0	NA	4.9	220	Y	Not a CoPEC: Not detected and MRL<SL
Dimethyl phthalate	SVOC		4	0	0	NA	4.9	3	Y	ND CoPEC: MRL>SL and historical use
Di-N-Butyl Phthalate	SVOC		4	0	0	NA	4.9	19	Y	Not a CoPEC: Not detected and MRL<SL
Di-N-Octyl Phthalate	SVOC		4	0	0	NA	4.9	22	Y	Not a CoPEC: Not detected and MRL<SL
Fluoranthene	PAH	B	4	0	0	NA	0.05	8.1	Y	Not a CoPEC: Not detected and MRL<SL
Fluorene	PAH	B	4	0	0	NA	0.1	3.9	Y	Not a CoPEC: Not detected and MRL<SL
Hexachlorobenzene	SVOC	B	4	0	0	NA	0.05	0.0003	Y	ND CoPEC: MRL>SL and historical use
Hexachlorocyclopentadiene	SVOC	B	4	0	0	NA	0.05	5.2	Y	Not a CoPEC: Not detected and MRL<SL
Hexachloroethane	SVOC	B	4	0	0	NA	0.49	12	Y	Not a CoPEC: Not detected and MRL<SL
Indeno(1,2,3-cd)pyrene	PAH	B	4	0	0	NA	0.05	4.31	Y	Not a CoPEC: Not detected and MRL<SL
Isophorone	SVOC		4	0	0	NA	4.9	920	Y	Not a CoPEC: Not detected and MRL<SL
Nitrobenzene	SVOC		4	0	0	NA	0.1	220	Y	Not a CoPEC: Not detected and MRL<SL
N-Nitrosodimethylamine	SVOC		4	0	0	NA	4.9	117	Y	Not a CoPEC: Not detected and MRL<SL
N-Nitroso-di-N-propylamine	SVOC		4	0	0	NA	4.9	NR	Y	Not a CoPEC: Not detected and No SL
N-Nitrosodiphenylamine	SVOC		4	0	0	NA	4.9	210	Y	Not a CoPEC: Not detected and MRL<SL
Pentachloronitrobenzene	SVOC		4	0	0	NA	0.1	NR	Y	Not a CoPEC: Not detected and No SL
Pentachlorophenol	SVOC	B	4	0	0	NA	0.79	15	Y	Not a CoPEC: Not detected and MRL<SL
Phenanthrene	PAH	B	4	0	0	NA	0.05	6.3	Y	Not a CoPEC: Not detected and MRL<SL
Phenol	SVOC	B	4	0	0	NA	0.99	4	Y	Not a CoPEC: Not detected and MRL<SL
Pyrene	PAH	B	4	0	0	NA	0.05	0.025	Y	ND CoPEC: MRL>SL and historical use
Pyridine	SVOC		4	0	0	NA	0.49	2380	Y	Not a CoPEC: Not detected and MRL<SL
Naphthalene	PAH		4	0	0	NA	0.1	24	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethane, 1,1,1,2-	VOC	B	4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethane, 1,1,1-	VOC		4	0	0	NA	1	62	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethane, 1,1,2,2-	VOC	B	4	0	0	NA	0.5	420	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorotrifluoroethane, 1,1,2-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethane, 1,1,2-	VOC		4	0	0	NA	1	1200	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethane, 1,1-	VOC		4	0	0	NA	1	47	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethene, 1,1-	VOC		4	0	0	NA	1	25	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropene, 1,1-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorobenzene, 1,2,3-	VOC		4	0	0	NA	1	8	Y	Not a CoPEC: Not detected and MRL<SL
Trichloropropane, 1,2,3-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Trichlorobenzene,1,2,4-	VOC	B	4	0	0	NA	4.7	24	Y	Not a CoPEC: Not detected and MRL<SL
Trimethylbenzene, 1,2,4-	VOC	B	4	0	0	NA	1	33	Y	Not a CoPEC: Not detected and MRL<SL

Table B-2. Selection of chemicals of potential ecological concern-surface water, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (ug/L)	Maximum Reporting Limit (ug/L)	Surface Water SL (ug/L)	Historical evidence (Y/N)	CoPEC Determination
Dibromo-3-chloropropane,1,2-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorobenzene, 1,2- (o-DCB)	VOC	B	4	0	0	NA	2.5	14	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethane, 1,2-	VOC		4	0	0	NA	0.6	910	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 1,2-	VOC		4	0	0	NA	1	5700	Y	Not a CoPEC: Not detected and MRL<SL
Trimethylbenzene, 1,3,5-	VOC		4	0	0	NA	1	71	Y	Not a CoPEC: Not detected and MRL<SL
Dichlorobenzene, 1,3-(m-DCB)	VOC	B	4	0	0	NA	2.5	71	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 1,3-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorobenzene, 1,4- (p-DCB)	VOC	B	4	0	0	NA	2.5	15	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropane, 2,2-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Chlorotoluene, 2-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Methyl butyl ketone (2-Hexanone)	VOC		4	0	0	NA	5	99	Y	Not a CoPEC: Not detected and MRL<SL
Isopropyltoluene, 2- (o-Cymene)	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Chlorotoluene, 4-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Isopropyltoluene, 4- (p-Cymene)	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Methyl Isobutyl Ketone (4-Methyl-2-pentanone)	VOC		4	0	0	NA	5	170	Y	Not a CoPEC: Not detected and MRL<SL
Acetone	VOC		4	0	0	NA	25	1500	Y	Not a CoPEC: Not detected and MRL<SL
Acrylonitrile	VOC		4	0	0	NA	5	2600	Y	Not a CoPEC: Not detected and MRL<SL
Benzene	VOC		4	0	0	NA	0.7	46	Y	Not a CoPEC: Not detected and MRL<SL
Bromobenzene	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Bromochloromethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Bromodichloromethane	VOC		4	0	0	NA	0.5	11000	Y	Not a CoPEC: Not detected and MRL<SL
Bromoform	VOC		4	0	0	NA	1	320	Y	Not a CoPEC: Not detected and MRL<SL
Bromomethane	VOC		4	0	0	NA	1	16	Y	Not a CoPEC: Not detected and MRL<SL
Butylbenzene, n-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Butylbenzene, sec-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Butylbenzene, tert-	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Carbon disulfide	VOC		4	0	0	NA	5	0.92	Y	ND CoPEC: MRL>SL and historical use
Carbon tetrachloride	VOC		4	0	0	NA	1	9.8	Y	Not a CoPEC: Not detected and MRL<SL
Chlorobenzene	VOC		4	0	0	NA	1	130	Y	Not a CoPEC: Not detected and MRL<SL
Chloroethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Chloroform	VOC		4	0	0	NA	1	28	Y	Not a CoPEC: Not detected and MRL<SL
Chloromethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Dichloroethene, cis-1,2-	VOC		4	0	0	NA	1	590	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropene, cis-1,3-	VOC		4	0	0	NA	0.4	0.055	Y	ND CoPEC: MRL>SL and historical use
Dibromochloromethane	VOC		4	0	0	NA	0.5	NR	Y	Not a CoPEC: Not detected and No SL
Dibromomethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Dichlorodifluoromethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Ethylbenzene	VOC		4	0	0	NA	1	290	Y	Not a CoPEC: Not detected and MRL<SL
Ethylene Dibromide (EDB)	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL
Hexachlorobutadiene	VOC	B	4	0	0	NA	0.49	1.3	Y	Not a CoPEC: Not detected and MRL<SL
Isopropylbenzene (cumene)	VOC		4	0	0	NA	1	2.6	Y	Not a CoPEC: Not detected and MRL<SL
Xylene, m,p-	VOC		4	0	0	NA	1	1.8	Y	Not a CoPEC: Not detected and MRL<SL
Methyl ethyl ketone	VOC		4	0	0	NA	5	14000	Y	Not a CoPEC: Not detected and MRL<SL
Methyl Tert-Butyl Ether (MTBE)	VOC		4	0	0	NA	1	11070	Y	Not a CoPEC: Not detected and MRL<SL
Methylene Chloride (Dichloromethane)	VOC		4	0	0	NA	1	2200	Y	Not a CoPEC: Not detected and MRL<SL
Propylbenzene, n-	VOC		4	0	0	NA	1	128	Y	Not a CoPEC: Not detected and MRL<SL
Xylene, o-	VOC		4	0	0	NA	1	13	Y	Not a CoPEC: Not detected and MRL<SL
Styrene	VOC		4	0	0	NA	1	72	Y	Not a CoPEC: Not detected and MRL<SL
Tetrachloroethylene (PCE)	VOC		4	0	0	NA	1	120	Y	Not a CoPEC: Not detected and MRL<SL
Tetrahydrofuran	VOC		4	0	0	NA	2.5	NR	Y	Not a CoPEC: Not detected and No SL
Toluene	VOC		4	0	0	NA	1	9.8	Y	Not a CoPEC: Not detected and MRL<SL
Dichloroethene, trans-1,2-	VOC		4	0	0	NA	1	590	Y	Not a CoPEC: Not detected and MRL<SL
Dichloropropene, trans-1,3-	VOC		4	0	0	NA	0.4	0.055	Y	ND CoPEC: MRL>SL and historical use
Dichloro-2-butene, trans-1,4-	VOC		4	0	0	NA	5	NR	Y	Not a CoPEC: Not detected and No SL
Trichloroethylene (TCE)	VOC		4	0	0	NA	1	21	Y	Not a CoPEC: Not detected and MRL<SL
Trichlorofluoromethane	VOC		4	0	0	NA	1	NR	Y	Not a CoPEC: Not detected and No SL

Table B-2. Selection of chemicals of potential ecological concern-surface water, Hockanum River at the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Chemical	Class	BCC	Number of Samples	Number of Detections	Detection Frequency (%)	Maximum Detected Conc. (ug/L)	Maximum Reporting Limit (ug/L)	Surface Water SL (ug/L)	Historical evidence (Y/N)	CoPEC Determination
Vinyl Chloride	VOC		4	0	0	NA	1	930	Y	Not a CoPEC: Not detected and MRL<SL
Xylene (Total)	VOC		4	0	0	NA	1	13	Y	Not a CoPEC: Not detected and MRL<SL

Notes:
BCC - bioaccumulative chemical compound
CoPEC - chemical of potential ecological concern
MDC - maximum detected concentration
ug/L - microgram per liter
MRL - maximum reporting limit
NA - not available
ND - not detected
NR - not reported
PAHs - polycyclic aromatic hydrocarbons
SL - screening level
SVOC - semi-volatile organic compound
VOC - volatile organic compound

Appendix C

Amphibian Water Values

Table C-1. Amphibian water values

Chemical	Organism	Organism Common Name	Effect Conc	Unit	Type of Effect Level	Endpoint	Exposure Duration (Days)	Notes	Reference Cited in U.S. EPA's ECOTOX
Metals									
Arsenic	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	40	µg/L	LC50	Mortality	7	Lowest of all relevant effect levels in ECOTOX	Birge 1978
Barium	Rana sp.	Frog	244300	µg/L	--	Development	<4	Lowest of all relevant effect levels in ECOTOX	Dowden et al. 1965
Cadmium	*Duttaphrynus melanostictus*	Asian Common Toad	19	µg/L	LOEC	Growth	5	Lowest of all relevant effect levels in ECOTOX	Ranatunge et al. 2012
Chromium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	30	µg/L	LC50	Mortality	7	ECOTOX contained 2 relevant studies; selected lowest effect level	Birge 1978
Copper	*Ambystoma jeffersonianum*	Jefferson's Salamander	15	µg/L	LC100	Mortality	n/r	Lowest of all relevant effect levels in ECOTOX	Horne and Dunson 1995
Lead	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	40	µg/L	LC50	Mortality	7	Lowest of all relevant effect levels in ECOTOX	Birge 1978
Mercury	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	1	µg/L	LC50	Mortality	7	Lowest of all relevant effect levels in ECOTOX	Birge 1978
Nickel	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	50	µg/L	LC50	Mortality	7	Lowest of all relevant effect levels in ECOTOX	Birge 1978
Vanadium	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	250	µg/L	LC50	Mortality	7	ECOTOX contained one relevant study	Birge 1978
Zinc	*Gastrophryne carolinensis*	Eastern Narrow-Mouthed Toad	10	µg/L	LC50	Mortality	7	ECOTOX contained 2 relevant studies; selected lowest effect level	Birge 1978
Semivolatile Organic Compounds									
2-Methylnaphthalene			n/a						
Dibenz[a,h]anthracene			n/a						
Acenaphthene			n/a						
Acenaphthylene			n/a						
Anthracene	*Lithobates pipiens*	Leopard Frog	25	µg/L	LC50	Mortality	0.2083	Lowest of all relevant effect levels in ECOTOX	Kagan et al. 1984
Benz[a]anthracene			n/a						
Benzo[a]pyrene	*Xenopus laevis*	African Clawed Frog	3330	µg/L	EC50	Development	4	Lowest of all relevant effect levels in ECOTOX	Saka et al. 2004
Benzo[b]fluoranthene			n/a						
Benzo[e]pyrene			n/a						
Benzo[ghi]perylene			n/a						
Benzo[k]fluoranthene			n/a						
Chrysene			n/a						
Fluoranthene	*Xenopus laevis*	African Clawed Frog	52	µg/L	EC50	Development	4	Lowest of all relevant effect levels in ECOTOX	Hatch 1998
Fluorene			n/a						
Indeno[1,2,3-cd]pyrene			n/a						
Naphthalene	*Xenopus laevis*	African Clawed Frog	2100	µg/L	LC50	Mortality	4	ECOTOX contained one relevant study; selected lowest effect level	Edmisten and Bantle 1982
Perylene			n/a						
Phenanthrene			n/a						
Pyrene	*Lithobates pipiens*	Leopard Frog	140	µg/L	LC50	Mortality	1	ECOTOX contained one relevant study	Kagan et al. 1987
Total PAHs			n/a						

Notes:
LC50 - lethal concentration for 50% of test organisms
LC100 - lethal concentration for 100% of test organisms
Only CoPECs are shown.
n/a = not available
PAHs - polycyclic aromatic hydrocarbons

Appendix D

Wildlife Toxicity Reference Values Development

Wildlife Toxicity Reference Value Development

Exponent developed wildlife toxicity reference values (TRVs) for those chemicals identified as chemicals of potential ecological concern (CoPECs). In accordance with U.S. EPA (1997, 1998) guidance for conducting environmental risk characterizations, TRVs are the no-observed-adverse-effect level (NOAEL) and the lowest-observed-adverse-effect level (LOAEL). NOAELs and LOAELs for the wildlife species are based on the results of laboratory studies reported in the literature. The NOAEL is the highest concentration of a particular contaminant at which no adverse effects are observed in the test species. The LOAEL is the lowest concentration of a particular contaminant at which adverse effects are observed in the test species. NOAELs and LOAELs are daily doses of COCs (mg of chemical/kg body weight/day [mg/kg/d]), which are compared to the exposure doses (mg/kg/d) calculated in wildlife exposure models.

Sources of the TRVs for avian and mammalian species include Sample et al. (1996), U.S. Environmental Protection Agency (EPA) Ecological Soil Screening Levels (EcoSSLs), [1] and various databases. EPA recently developed EcoSSLs for a number of metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc), DDT, dieldrin, PAHs, and pentachlorophenol. In developing the EcoSSLs, EPA reviewed the toxicological literature and selected studies to form the basis for wildlife TRVs. For those chemicals for which EPA developed EcoSSL TRVs for birds and mammals, Exponent reviewed the key studies for possible use in the development of the wildlife TRVs used in this assessment. Exponent also reviewed the studies used by Sample et al. (1996) for possible use in developing the avian and mammalian TRVs. For COCs not reviewed in the EPA EcoSSL documents or Sample et al. (1996), the Agency of Toxic Substances and Disease Registry (ATSDR), [2] the EPA's Integrated Risk Information System (IRIS)[3] and/or the scientific literature was searched for suitable studies to develop avian and mammalian TRVs.

A number of considerations were used when selecting a study for TRV derivation, including:

- Test species relevance to receptor species — Ideally, studies on wildlife species are preferred for TRV development; however, very few toxicological studies on wildlife species have been conducted. Therefore, studies on laboratory rodents (e.g., rats and mice) and common avian test species (e.g., Japanese quail) were reviewed and considered for TRV development. Where there are studies on these species or wildlife species, studies with domesticated species, such as chickens, cattle, pigs, and dogs, were not considered for TRV development.

- Relevant exposure route — The preferred oral route of exposure for TRV development is when the chemical has been added to the food of the test animal. This exposure in food provides a better estimate of wildlife exposure

[1] Online at http://www.epa.gov/ecotox/ecossl/.

[2] Online at http://www.atsdr.cdc.gov/toxpro2.html.

[3] Online at http://www.epa.gov/iris/.

to chemicals in the environment than exposure by gavage, oral capsule, or in drinking water. Inorganic and organic chemicals dissolved in drinking water or a capsule are typically in a form (e.g., inorganic salts) that is much more bioavailable than the forms in which a chemical would be found in the environment, and thus would not produce realistic assessments of potential environmental toxicity. Given that metals and organic chemicals partition from water to food, soil, or sediment in the environment, these exposure routes are not as relevant as in food.

- Study of adequate chronic duration — Studies of chronic duration are preferred over short-term studies for TRV development. For mammals, a study is considered chronic if the exposure was at least one-half of the test animal's lifespan or occurred during a critical life stage, such as reproduction and development. For birds, a study was considered chronic if the exposure was at least 10 weeks or occurred during reproduction or development.

- Provide adequate controls — Laboratory studies without adequate controls were not considered for TRV development. Laboratory studies with a control group exposed to an exposure medium without chemicals added were preferred over field studies where such controls do not exist.

- Adequate statistical methods — Studies conducted appropriate statistical analyses to determine the significant differences between the control and treatment groups were preferred.

- Adequate sample size — A sample size of three is required for consideration in the TRV development. Studies with larger sample sizes are preferred.

- Daily dose or adequate dosing information — Studies that report the effect concentrations as daily doses (e.g., milligram chemical/kilogram body weight/day) or information necessary to calculate the daily dose (e.g., test-animal ingestion rate or body weight and food consumed) were preferred over studies lacking this information.

- Reproductive, growth, or survival endpoints — Studies that report effects on ecologically relevant endpoints, reproduction, growth, and survival, were considered for TRV development. Behavioral, pathological, biochemical, or physiological endpoints were not considered for TRV development unless they were linked to the ecologically relevant endpoints. Reproductive endpoints were preferred to growth and survival.

- Absence of confounding factors — Studies that controlled for confounding factors are preferred. For example, studies that exposed test organisms to multiple chemicals were not used for TRV development.

- Provides a dose-response — Studies that demonstrate increasing chemical levels related to increasing severity of effect are preferred, because they provides evidence that the treatment is the cause of the observed effect.

- Reports both a NOAEL and a LOAEL — Studies that report both a NOAEL and LOAEL are preferred, because these studies (1) report the statistically-significant-effect level and (2) bound the adverse-effect level, thus reducing uncertainty in the use of the study to develop TRVs.

If only subchronic studies were available for selecting chronic TRVs, an acute-to-chronic ratio of 10 (Sample et al. 1996) was applied. If only a LOAEL was provided by the authors of the selected study, then the LOAEL was divided by a factor of 10 to derive the NOAEL benchmark.

Doses of metal salts and organic chemicals of less than 100% purity were adjusted by multiplying the dose by the percent molecular weight. This is consistent with the EcoSSL TRV development methodology.

No studies exist for the mammalian wildlife evaluated in this ERC (e.g., short-tailed shrew, meadow vole, raccoon, river otter); therefore, TRVs (either NOAEL or LOAEL) were derived from rat, mouse, rabbit, and mink studies using this allometric relationship described by Sample et al. (1996):

$$NOAEL_w = NOAEL_t \{bw_t/bw_w\}^{1/4}$$

where:

$NOAEL_w$ is the NOAEL for the wildlife species in question;

$NOAEL_t$ is the NOAEL for the test species;

bw_t is the body weight of the test species;

bw_w is the body weight of the wildlife species in question.

Note that smaller animals will have larger NOAELs because, according to Sample et al. (1996), the smaller animals tend to have higher metabolic rates and are more resistant to toxic chemicals. Table D-1 contains the information on the studies used to develop TRVs for mammalian receptors. Table D-2 contains the allometrically-adjusted TRVs for mammalian receptors used in this ERC.

Table D-3 provides the information on the studies used to develop TRVs for avian receptors. Allometric adjustments of TRVs are not recommended for avian receptors.

Below are descriptions of the studies used to develop the wildlife TRVs, and the rationale for using those studies to develop the wildlife TRVs.

Arsenic

Birds: The EPA EcoSSL TRV for arsenic (As) for birds is NOAEL = 2.24 mg/kg/d. There were no bounded LOAELs reported by EPA. EPA states that the NOAEL is based on the lowest

NOAEL for growth, survival, and reproduction. This value was derived from a study on chickens by Holcman and Stibilj (1997). This study was not considered in the TRV derivation process, because chickens are not the most appropriate surrogate species for wildlife receptors, and other studies on more suitable species are available. EPA listed two other studies with relevant endpoints that were conducted on mallards. These other mallard studies listed by EPA were eliminated from consideration as the basis for TRVs, because the one study by Hoffman et al. (1992) tested only one arsenic concentration (no dose-response), and the other by Camardese et al. (1990) showed only growth effects, which were inconsistent between sexes. EPA listed the study that is the basis for the TRVs used here (Stanley et al. 1994) as among those considered for their avian TRVs, but the data from Stanley et al. were not included in EPA's table of data extracted for avian TRV derivation.

The selected avian TRVs (NOAEL = 10 mg/kg/d, LOAEL = 38 mg/kg/d) for As (test chemical was sodium arsenate; As5+) are based on mallard reproductive effects, derived from the study by Stanley et al. (1994). In this study, mallards were fed feed mixed with sodium arsenate; results are presented as As, dry weight. The study found that duckling production (number of ducklings alive at day 14) was significantly reduced in the exposure group with 400 ppm As added to the diet. At 100 ppm, there was no effect on duckling production. One drawback to this study by Stanley et al. (1994) is that the ingestion rate and mallard body weight were not specified; therefore, these had to be derived from other literature for the purposes of TRV derivation. However, this study measured endpoints that are ecologically relevant in an appropriate test species and remains the most appropriate study for TRV derivation.

Mammals: The EPA EcoSSL TRVs for As for mammals are NOAEL =1.04 mg/kg/d, and LOAEL = 1.66 mg/kg/d. The EPA NOAEL is the highest bounded NOAEL that is lower than the lowest bounded LOAEL for reproduction, growth, and survival. These EPA TRVs, from a study by Neiger and Osweiler (1989) conducted on beagle dogs, are based on a growth endpoint (fraction of initial body weight). In this study, inorganic As (sodium arsenite; As3+) in feed resulted in feed rejection, and decreased feed intake resulted in reduced body weight.

A recent study by Nemec et al. (1998), studied the effects of As in mice and New Zealand White rabbits on both reproduction and survival during gestation days 0 through 18. Although the study duration was relatively short and dose was by gavage, the study is appropriate for TRV derivation, because it was conducted during a critical life stage and assessed both reproductive and survival endpoints in two mammalian species. Therefore, this study was considered more appropriate for TRV derivation than the study selected by EPA (Neiger and Osweiler 1989). Nemec et al. (1998) exposed mice and rabbits to arsenic acid, a form of organic As (As5+) during gestation and evaluated maternal mortality, pathology, and body weight, as well as reproductive effects including embryo/fetal effects. The NOAEL for maternal and reproductive effects in mice was 24 mg/kg/d, and the unbounded LOAEL was 48 mg/kg/d (for both maternal mortality and body weight, and reproductive effects). Rabbits were found to be more sensitive to As. Maternal mortality and fetal resorption occurred in rabbits exposed to the highest dose, 3 mg/kg/d (unbounded LOAEL), and there were no effects on rabbit mortality or reproduction at 0.75 mg/kg/d (NOAEL). Therefore, the selected mammalian TRVs for As are NOAEL = 0.75 mg/kg/d and LOAEL = 3.0 mg/kg/d.

Barium

Birds: EPA does not provide EcoSSL TRVs barium (Ba) for birds, and all of the studies except one (Johnson et al. 1960) were rejected for use in deriving an avian TRV. This study was used to develop the barium TRVs for birds in this evaluation. Johnson et al. (1960) fed 1-day-old chicks 0, 250, 500, 1000, 2000, 4000, 8000, 16000, or 32000 ppm Ba as barium hydroxide in feed to groups of twenty female chicks for four weeks. The 2000-ppm Ba diet had no effect on mortality. There was a slight depression in growth or chicks that ate the 2000-ppm Ba diet, but this was not significant. The 4000- to 32000-ppm diets resulted in 5% to 100% mortality. This study did not provide information needed to develop a daily dose, and body weight and ingestion rate were assumed (Table D-3). This study was four weeks long and considered to be a subchronic exposure, and a subchronic-to-chronic uncertainty factor of 0.1 was applied to the NOAEL and LOAEL. The resulting NOAEL TRV is 21 mg/kg/d, and the LOAEL TRV is 42 mg/kg/d.

Mammals: The EPA EcoSSL TRV for Ba for mammals is a NOAEL of 51.8 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth, and is lower than the lowest bounded NOAEL for reproduction, growth, and survival. The EPA EcoSSL is based on two studies: Borzelleca et al. (1988) and Dietz et al. (1992). Borzelleca et al. (1988) administered barium chloride to juvenile rats for 10 days and observed reduced survival at 209 mg/kg/d. Dietz et al. (1992) exposed juvenile rats to barium chloride by gavage for 92 days and observed reduced growth in developing male rats at 121 mg/kg/d. The study by Dietz et al. (1992) was selected to develop the TRVs, because it was a longer study and reported effects on a more sensitive endpoint than the study by Borzelleca et al. (1988). The study by Dietz et al. (1992) is considered subchronic, and an uncertainty factor of 0.1 is applied to the NOAEL and LOAEL. The resulting NOAEL is 6.1 mg/kg/d and the LOAEL is 12 mg/kg/d.

Cadmium

Birds: The EPA EcoSSL TRV for cadmium (Cd) for birds is a NOAEL of 1.47 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth, and most of these are chicken studies. The EPA LOAEL is also based on a chicken study (Leach et al. 1979). Chickens are not good surrogate species for mallard or other wildlife species (in some cases, chickens have been shown to be among the most sensitive of bird species). Therefore, chicken studies were eliminated from consideration in this TRV derivation process, when data for a more relevant species were available. The only other study from the EPA EcoSSL list that was relevant (i.e., for a relevant species—mallard—reported a NOAEL and LOAEL, and for a relevant endpoint—reproduction) was Di Giulio and Scanlon (1984). This study was eliminated from further consideration, because copper and zinc were also present in the food that was given to the mallards, and these metals may also influence toxicity and/or induce antagonistic/synergistic effects.

The selected avian TRVs for Cd are based on mallard reproductive effects (egg production) observed in a study by White and Finley (1978). In this study, adult mallards were fed breeder mash with Cd chloride for 90 days. Egg production was suppressed in the mallards fed 210 ppm

Cd (LOAEL), whereas mallards fed 1.6 to 15.2 ppm Cd were not affected (NOAEL). The resulting NOAEL and LOAEL for Cd based on this study are 1.45 mg/kg/d and 20 mg/kg/d, respectively.

Mammals: The EPA EcoSSL TRVs for Cd in mammals are a NOAEL of 0.77 mg/kg/d, and a LOAEL of 1.0 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL that is lower than the lowest bounded LOAEL for reproduction, growth, or survival. The EPA NOAEL is from a study by Yuhas et al. (1979) on rat growth. However, rats were dosed with Cd in drinking water. Therefore, this study was eliminated from further consideration for TRV derivation, because food or gavage studies are more relevant oral exposure routes than drinking water. The EPA LOAEL, 1.0 mg/kg/d, is very close to the EPA NOAEL of 0.77 mg/kg/d. This LOAEL, for which EPA states that the TRV is the lowest bounded LOAEL from the EcoSSL studies, is based on a rat study (Rastogi et al. 1977), in which rats were dosed by gavage and the endpoint was growth (body weight). Other available Cd mammalian studies that reported both NOAELs and LOAELs for relevant endpoints were eliminated, because important parameters were not specified in the studies (e.g., weight of the test animals, how much they were fed), or because study duration or samples sizes were inadequate.

The study by Sutou et al. (1980) was selected for TRV development for mammals and Cd, because the endpoint in this study was reproduction, which is a more ecologically relevant and preferred endpoint than change in body weight. In this study, in female rats dosed by gavage at 10 mg/kg/d Cd for 6 weeks, the numbers of copulating and pregnant females decreased, the average numbers of total implantations and live fetuses decreased, the average number of resorbed fetuses increased, and fetus growth also decreased significantly from the control. There were no significant effects in the 1.0 mg/kg/d exposure group. Therefore, the Cd NOAEL TRV is 1.0 mg/kg/d and the LOAEL TRV is 10 mg/kg/d.

Chromium

Birds: EPA did not calculate an EcoSSL TRV for Cr6+, because there were not enough study results to meet the minimum data requirements. The EPA EcoSSL TRV for Cr3+ for birds is a NOAEL of 2.66 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth. The EPA EcoSSL TRV for Cr3+ for birds is also based on a study on the effects of chromium on black ducks by Haseltine et al. (unpublished data). Sample et al. (1996) used this same study to develop chronic TRVs for birds. The only other study used by EPA to develop the EcoSSL for birds that reported both a NOAEL and a LOAEL for relevant endpoints for birds was of shorter duration than Haseltine et al. (unpublished data) and used chickens, which are not as ecologically relevant as black ducks. Therefore, the Haseltine et al. data is used to develop the chromium TRVs for birds. In this study, Haseltine et al. exposed black ducks to 0, 10, or 50 ppm Cr+3 in the diet for 10 months and observed reduced duckling survival at the 50-ppm dose level. No significant differences in duckling survival were observed at the 10-ppm dose level. This study did not provide information needed to develop a daily dose, and body weight and ingestion rate were assumed (Table D-3). The resulting chromium NOAEL is 1.5 mg/kg/d, and the LOAEL is 7.5 mg/kg/d.

Mammals: The EPA EcoSSL TRV for Cr3+ for mammals is a NOAEL of 2.40 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth. EPA also developed an EcoSSL TRV for Cr6+, and this value is 5.66 mg/kg/d—the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and survival. A key study used to develop the EcoSSL TRV for Cr3+ is a study by Zahid et al. (1990). This study was the source of the lowest LOAEL used by EPA in developing the EcoSSL TRV for Cr3+. In this study, mice were fed 0, 100, 200, or 400 mg/kg chromium sulfate (38.02% Cr3+ by molecular weight) in food for 35 days. Decreased sperm count was observed in mice fed a 100-ppm dose, the lowest dose tested. This study provided information needed to calculate the daily dose, and the resulting LOAEL is 5.96 mg/kg/d. To estimate a NOAEL, the LOAEL is divided by 10, resulting in a NOAEL of 0.596 mg/kg/d. The Zahid et al. (1990) study was selected to develop the chromium TRV for mammals, because other studies with both NOAELs and LOAELs used shorter exposure duration, less preferred exposure routes, or higher final NOAELs and LOAELs.

Copper

Birds: The EPA EcoSSL TRV for copper (Cu) for birds is a NOAEL of 4.05 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The EPA NOAEL is based on a chicken study (Ankari et al. 1998). Chickens are not good surrogate species for mallard or other wildlife species (in some cases, chickens have been shown to be among the most sensitive of bird species). Therefore, chicken studies were eliminated from consideration in this TRV derivation process when data for a more relevant species were available. The only other study from the EPA EcoSSL list that was relevant (i.e., for a relevant species, reported a NOAEL and LOAEL, and for a relevant endpoint) was Foster (1999). In this study, juvenile ducks were fed 0, 218.5, 420, or 1024 ppm Cu in food for 34 days, and reduced growth was observed in the 420-ppm group, but growth was in the 218.5-ppm group. This study reported information needed to calculate daily doses, and the resulting NOAEL is 56.8 mg/kg/d and LOAEL is 109 mg/kg/d. Because the exposure duration of this study was only 35 days, a subchronic-to-chronic uncertainty factor of 0.1 was applied. The final Cu NOAEL for birds is 5.68 mg/kg/d, and Cu LOAEL for birds is 10.9 mg/kg/d.

Mammals: The EPA EcoSSL TRV for Cu for mammals is a NOAEL of 5.06 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The EPA NOAEL is based on a mink study (Aulerich et al. 1982). Other available Cu mammalian studies that reported both NOAELs and LOAELs for relevant endpoints were not considered in this TRV selection process, because the study durations were shorter than the study by Aulerich et al. (1982). Aulerich et al. (1982) fed 0, 25, 50, 100, or 200 ppm Cu in food to juvenile mink for 357 days. The feed without addition of Cu contained 60.5 ppm; this base level of Cu should be added to the Cu doses. Kit mortality was observed in the 50-ppm group, but not the 25-ppm group. This study did not provide necessary information to estimate the daily doses, and body weight and ingestion rate values were assumed (Table D-1). The NOAEL is 11.7 mg/kg/d (25 mg/kg diet + 60.5 mg/kg in food * 0.137 kg food/kg body weight/d) and the LOAEL is 15.1 mg/kg/d (50 mg/kg diet + 60.5 mg/kg in food * 0.137 kg food/kg body weight/d).

Lead

Birds: The EPA EcoSSL TRV for lead (Pb) for birds is a NOAEL of 1.63 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The EPA NOAEL is based on a chicken study (Edens and Garlich 1983). Chickens are not good surrogate species for mallard or other wildlife species (in some cases, chickens have been shown to be among the most sensitive of bird species). Therefore, chicken studies were eliminated from consideration in this TRV derivation process, when data for a more relevant species were available. Studies using preferred exposure routes, duration, and endpoints, as well as reporting both a NOAEL and LOAEL, were limited to studies using Japanese quail. However, studies on American kestrels were available (Hoffman et al. 1985; Pattee 1984). These studies were selected over the studies with Japanese quail, because kestrels are important wildlife species and represent birds that are generally more sensitive to bioaccumulating chemicals, such as lead, because they are top-level predators. The study by Hoffman et al. (1985) used a non-preferred exposure route (gavage) to treat kestrels with lead. Therefore, the study by Pattee (1984), in which American kestrels were fed lead in food for seven months, was selected for lead TRV development. Pattee (1984) fed sixteen breeding pairs of kestrels 0, 10, or 50 ppm Pb in food for seven months. No adverse effects on egg laying, fertility, or eggshell thickness were observed in 10- or 50-ppm Pb groups. The mean Pb level in the 50-ppm diet fed to kestrels was 54 ppm. This study did not provide daily doses of lead, but did provide body-weight data. Using the body weight and a food ingestion rate of 10 g/day (Sample et al. 1996), the resulting Pb NOAEL for birds is 3.75 mg/kg/d.

For a LOAEL, the geometric mean of LOAELs for reproduction and growth for bird species was taken and used in this ERC. That value is 25.5 mg/kg/day (Table D-4). Only studies that showed no more than 20% reduction in growth or reproduction were used to calculate the LOAEL.

Mammals: The EPA EcoSSL TRV for Pb for mammals is a NOAEL of 4.70 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. This is based on a study that dosed rats with lead in drinking water, which is not the preferred exposure route. Therefore, a study by Azar et al. (1973), in which rats were fed lead in food (0, 10, 50, 100, 500, 1000, or 2000 ppm Pb) for three generations, was selected for lead TRV development. While other available studies used relevant test animals, those studies used shorter exposure durations than the study by Azar et al. (1973) or did not use the preferred exposure route (oral in food). The average weight of weanling rats decreased in the 1000-ppm and 2000-ppm Pb groups, but did not decrease in the 0-, 10-, 50-, and 100-ppm Pb groups. The measured Pb concentrations in the 100-ppm and 1000-ppm diets were 141 and 1130 ppm, respectively. This study did not provide information needed to develop daily doses, and a body weight and ingestion rate was assumed (Table D-1). The resulting Pb NOAEL for mammals is 11 mg/kg/d, and the LOAEL is 90 mg/kg/d.

Mercury

Birds: EPA does not provide mercury (Hg) EcoSSL TRVs for birds. Once mercury moves into the foodchain the predominant form is meHg and is a greater risk because meHg biomagnifies.

Fuchsman et al. (2017) conducted an extensive review of the effects of methylmercury (meHg) on bird reproduction. Fuchsman et al. found typical ranges of meHg thresholds for adverse effects on avian reproductive success are approximately 0.05 mg/kg/d to 0.5 mg/kg/d. Therefore, the lower threshold was selected as the NOAEL (0.05 mg/kg/d) and the upper threshold was selected as the LOAEL (0.5 mg/kg/day).

Mammals: EPA does not provide Hg EcoSSL TRVs for mammals. Sample et al. (1996) provides mgHg TRVs for mammals based on a study by Verschuuren (1976, as cited in Sample et al. [1996]). In that study, rats were exposed to meHg in the diet at three dose levels (0.1, 0.5, and 2.5 mg meHg/kg) for three generations. The highest dose (2.5 mg meHg/kg) resulted in reduced pup viability, but no adverse reproductive effects were observed in rats at other two doses (0.1 or 0.5 mg mgHg/kg). The NOAEL was considered to be 0.5 mg meHg/kg and the LOAEL was considered to be 2.5 mg meHg/kg. Using an ingestion rate of 0.028 kg/d and a body weight of 0.35 kg, the resulting NOAEL was 0.032 mg/kg/d and the LOAEL was 0.16 mg/kg/d.

Nickel

Birds: The EPA EcoSSL TRV for nickel (Ni) for birds is a NOAEL of 6.71 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth, which are mostly based on studies with chickens. EPA lists two studies on mallards (Eastin and O'Shea, 1981; Cain and Pafford, 1981) that use relevant route of exposure and endpoints. However, the study by Eastin and O'Shea does not provide both a NOAEL and LOAEL is not considered further in this TRV development process. Cain and Paddford (1981) fed juvenile mallards 0, 200, 800 or 1200 ppm Ni (as nickel sulfate) in food for 90 days. Growth and survival were significantly lower in the 800 ppm (774 ppm Ni) group, but were unaffected in the 200 ppm (176 ppm Ni) group. The body weight and ingestion rate was provided in this study (shown in Table D-3) and daily doses for the 200 (NOAEL) and 800 (LOAEL) ppm groups were calculated. The resulting Ni NOAEL is 31 mg/kg/d and the LOAEL is 135 mg/kg/d.

Mammals: The EPA EcoSSL TRV for Ni for mammals is a NOAEL of 7.70 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. This is based a study that dosed rats with Ni in drinking water, which is not the preferred exposure route. Therefore, a study by Ambrose et al. (1976), in which rats were fed Ni in food (0, 250, 500, or 1000 ppm nickel sulfate, 22% Ni) for three generations, was selected for Ni TRV development. While other available studies used relevant test animals, those studies used shorter exposure durations than the study by Ambrose et al. (1976), did not provide both NOAELs and LOAELs, or did not use the preferred exposure route (oral in food). The average weight of weanling rats decreased in the 1000-ppm group, but did not decrease in the 0-, 250-, and 500-ppm groups. This study did not provide the information needed to develop daily doses, and body weight and ingestion rate were assumed (Table D-1). The resulting Ni NOAEL for mammals is 9 mg/kg/d, and the LOAEL is 18 mg/kg/d, assuming the doses contained 22% nickel.

Vanadium

Birds: The EPA EcoSSL TRV for V for birds is a NOAEL of 0.344 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The EPA NOAEL is based on a chicken study (Hill 1979). Chickens are not good surrogate species for mallard or other wildlife species, as discussed above. Therefore, chicken studies were eliminated from consideration in this TRV derivation process, when data for a more relevant species were available. The other available studies from the EPA EcoSSL list that were relevant (i.e., for a relevant species, used oral-in-food exposure route, and for a relevant endpoint), lacked LOAELs. Of these studies (White and Dieter 1978; Van Vleet et al. 1981; Hafez and Kratzer 1976), the study by White and Dieter (1978) used the longest exposure duration and provided the lowest NOAEL dose. Therefore, this study was used for this TRV derivation process. In this study, mallard ducks were fed 0, 1.87, 2.84, 10.36, or 110 ppm V in food for 12 weeks, and no significant effects on growth or survival were observed, even at the highest concentration tested (110-ppm group). This study reported information needed to calculate daily doses, and the resulting NOAEL is 11 mg/kg/d.

Mammals: The EPA EcoSSL TRV for V for birds is a NOAEL of 4.16 mg/kg/d. EPA states that the NOAEL is the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. The EPA NOAEL is based on a reproduction study with mice (Sanchez et al. 1991). The study by Sanchez et al (1991) used a non-preferred exposure route (gavage). Another study by Daniel and Lillie (1938) was selected for this TRV derivation process, because it used the preferred exposure route (oral in food), provided a NOAEL and LOAEL for an ecologically relevant endpoint (growth), and used a relevant test species (rat). The other available studies from the EPA EcoSSL list were eliminated, because those studies did not use relevant test species, did not use the oral-in-food exposure route, or did not provide both NOAELs and LOAELs for a relevant endpoint. Therefore, the Daniel and Lillie (1938) study was used for this TRV derivation process. In this study, juvenile rats were fed 0, 0.444, 1.03, 5.11, 9.78, or 19 mg V/kg/d in diet for 10 weeks. Reduced body weight (growth) was observed in rats fed 5.11 mg/kg/d, but not in rats fed 1.03, 0.444, or 0 mg/kg/d. This study is considered subchronic, because the exposure duration was less than one-half of the test species' lifespan. Therefore, the NOAEL is 1.03 mg/kg/d, and the LOAEL is 5.11 mg/kg/d after applying a subchronic-to-chronic uncertainty factor of 0.1 to the daily doses.

Zinc

Birds: The EPA EcoSSL TRV for zinc (Zn) for birds is a NOAEL of 66.1 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth data, and is the lowest bounded NOAEL for reproduction, growth, and survival. Most of the studies underlying the EPA EcoSSL TRV for Zn in birds use chickens, which are not preferred test organisms for developing TRVs for avian wildlife. One study by Gasaway and Buss (1972) fed juvenile mallards 0, 3000, 6000, 9000, or 12000 ppm Zn in food for 60 days. In this study, male ducks fed 3000 to 12000 ppm Zn for 60 days had significantly reduced gonad size, such that reproductive function was probably lost. While Gasaway and Buss (1972) did not determine a NOAEL, this study was selected for this TRV derivation process, because the other available studies that reported both NOAEL and LOAEL for relevant endpoints used Japanese quail as

the test species and a shorter exposure duration. Using the ingestion rate for mallards provided in the study and an assumed body weight for mallards (Table D-3), the LOAEL is 102 mg/kg/d. To estimate a NOAEL from the LOAEL in this study, a LOAEL-to-NOAEL uncertainty factor of 0.1 is applied, resulting in a NOAEL of 10.2 mg/kg/d.

Mammals: The EPA EcoSSL TRV for Zn for mammals is a NOAEL of 75.4 mg/kg/d. EPA states that the NOAEL is based on the geometric mean of NOAELs for reproduction and growth, and is the lowest bounded NOAEL for reproduction, growth, and survival. One of the key studies that were used to develop the EPA EcoSSL TRV for Zn was by Schlicker and Cox (1968). In this study, female rats were fed control diet, diet containing 0.2% Zn, or 0.4% Zn during gestation for sixteen days. Fetal development was normal in the fetus of mothers fed 0.2% Zn (2,000 ppm), but the weights of fetuses in mothers fed 0.4% Zn (4,000 ppm) were significantly reduced. This study did not provide the information needed to develop a daily dose, and a body weight and ingestion rate was assumed (Table D-1). The resulting NOAEL for reproduction is 160 mg/kg/d, and the LOAEL is 320 mg/kg/d. This study was used to develop the mammalian TRVs for Zn, because a NOAEL and LOAEL were determined, an ecologically relevant endpoint was reported, and the exposure duration was considered chronic. However, daily dose information was not provided. This study was selected to develop the NOAEL and LOAEL TRVs over other available studies, because other available Zn mammalian studies lacked both NOAELs and LOAELs for relevant endpoints, did not use ecologically relevant animals, or had higher effective doses than those in the Schlicker and Cox (1968) study.

Total PAHs

Birds: EPA does not provide EcoSSL TRVs for birds, and all of the studies except two (Trust et al. 1994; Landis Assoc. Inc. 1985) were rejected for use in deriving an avian TRV. The study by Landis Assoc. (1985) did not report a LOAEL and was eliminated from this TRV derivation process. The study by Trust et al. (1994) was used to develop the PAH TRVs for birds in this evaluation. Trust et al. (1994) fed nine-day-old European starlings 0, 2, or 20 mg/kg/d 7,12-dimethylbenz(a)anthracene in feed for five days. Starlings fed the 20-mg/kg/d dose exhibited significantly lower growth rates than those in the control group. Starlings fed 2 mg/kg/d exhibited statistically similar growth rates to those fed the control diet. This study was five days duration and was considered to be a subchronic exposure; a subchronic-to-chronic uncertainty factor of 0.1 was applied to the NOAEL and LOAEL. The resulting NOAEL TRV is 0.2 mg/kg/d, and the LOAEL TRV is 2 mg/kg/d.

Mammals: The EPA EcoSSL TRV for low-molecular-weight PAHs for mammals is a NOAEL of 65.6 mg/kg/d, and the TRV for high-molecular-weight PAHs for mammals is a NOAEL of 0.615 mg/kg/d. Both of these values are the highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, and mortality. Because the high-molecular-weight PAH NOAEL is lower than the low-molecular-weight PAH NOAEL, the studies used to develop the EPA high-molecular-weight PAH NOAEL will be considered for TRV derivation. The EPA high-molecular-weight NOAEL is based on a 2-year feeding study with mice (Culp et al. 1998). This study was selected over other available studies to develop the NOAEL and LOAEL TRVs, because other available high-molecular-weight PAH studies for mammals lacked both NOAELs and LOAELs for relevant endpoints, used shorter exposure durations, or had higher effective

doses than those in the Culp et al. (1998) study. In the Culp et al. (1998) study, mice were fed 0, 5, 25, or 100 ppm benzo(a)pyrene in the diet for 2 years. Survival of mice fed 25 ppm (LOAEL) or 100 ppm benzo(a)pyrene was significantly lower than those in the control group. Survival of mice fed 5 ppm (NOAEL) benzo(a)pyrene was similar to the control group. This study did not provide daily dose information, except for body weights for mice in the feeding study. A NOAEL of 0.8 mg/kg/d and a LOAEL of 3.8 mg/kg/d were estimated using the body-weight data from the study and an assumed ingestion rate (Table D-1).

References

Ambrose, A.M., P.S. Larson, J.F. Brozelleca, and G.R. Hennigar, Jr. 1976. Long-term toxicologic assessment of nickel in rats and dogs. J. Food Sci. Technol. 13:181-187.

Ankari, A., H. Najib, and A. al Hozab. 1998. Yolk and serum cholesterol and production traits, as affected by incorporating a supraoptimal amount of copper in the diet of the leghorn hen. Br. Poult. Sci. 39(3):393-397.

Aulerich, R.J., R.K. Ringer, M.R. Bleavins, and A. Napolitano. 1982. Effects of supplemental dietary copper on growth, reproductive performance and kit survival of standard dark mink and the acute toxicity of copper to mink. J. Anim. Sci. 55(2):337-343.

Azar, A., H.J. Trochimowicz, and M.E. Maxwell. 1973. Review of lead studies in animals carried out at Haskell Laboratory: Two-year feeding study and response to hemorrhage study. In: Environmental Health Aspects of Lead: Proceedings, International Symposium, D. Barth et al., Eds. Commission of European Communities. Pp. 199-210.

Bleavins, M.R., and R.J. Aulerich. 1981. Feed consumption and food passage time in mink (*Mustela vison*) and European ferrets (*Mustela putorius furo*). Lab. Anim. Sci. 31:268-269.

Borzelleca, J.F., L.W. Condie, Jr., and J.L. Egle, Jr. 1988. Short-term toxicity (one- and ten-day gavage) of barium chloride in male and female rats. J. Am. Coll. Toxicol. 7:675-685.

Cain, B.W., and E.A. Pafford. 1981. Effects of dietary nickel on survival and growth of mallard ducklings. Arch. Environ. Contam. Toxicol. 10(6): 737-745.

Calder, W.A., and E.J. Braun. 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol. 224:R601-R606.

Camardese, M.B., D.J. Hoffman, X. LeCaptain, J. Leonard, and G.W. Pendleton. 1990. Effects of arsenate on growth and physiology in mallard ducklings. Environ. Toxicol. Chem. 9(6):785-795.

Culp, S.J., D.W. Gaylor, W.G. Sheldon, L.S. Goldstein, and F.A. Beland. 1998. A comparison of the tumors induced by coal tar and benzo(a)pyrene in a 2-year bioassay. Carcinogenesis 19(1):117-124.

Daniel, E.P., and Lillie, R.D. 1938. Experimental vanadium poisoning in the white rat. Public Health Rep. 53:765.

Di Giulio, R.T., and P.F. Scanlon. 1984. Sublethal effects of cadmium ingestion on mallard ducks. Arch. Environ. Contam. Toxicol. 13(6):765-776.

Dieter, M.P., M.I. Luster, G.A. Boorman, C.W. Jameson, J.H. Dean, and J.W. Cox. 1983. Immunological and biochemical responses in mice treated with mercuric chloride. Toxicol. Appl. Pharmacol. 68:218–228.

Dietz, D.D., M.R. Elwell, W.E. Davis, Jr., and E.F. Meirhenry. 1992. Subchronic toxicity of barium chloride dehydrate administered to rats and mice in the drinking water. Fundam. Appl. Toxicol. 19:527-537.

Eastin, W.C. Jr., and T.J. O'Shea. 1981. Effects of dietary nickel on mallards. J. Toxicol. Environ. Health 7(6):883-892.

Edens, F.W., and J.D. Garlich. 1983. Lead-induced egg production decrease in leghorn and Japanese quail hens. Poult. Sci. 62(9):1757-1763.

Foster, S.D. 1999. The biological and physiological effects of excess copper in juvenile mallards (*Anas platyrhynchos*): An investigation of the toxicity of acid mine drainage in waterfowl. Masters Thesis. Colorado State University, Fort Collins, CO. 131 pp.

Gasaway, W.C., and I.O. Buss. 1972. Zinc toxicity in the mallard. J. Wildl. Manage. 36:1107-1117.

Hafez, Y.S.M., and F.H. Kratzer. 1976. The effect of pharmacological levels of dietary vanadium on the egg production, shell thickness and egg yolk cholesterol in laying hens and coturnix. Poult. Sci. 55(3):923-926.

Hill, C.H. 1979. The effect of dietary protein levels on mineral toxicity in chicks. J. Nutr. 109(3):501-507.

Hoffman, D.J., J.C. Franson, O.H. Pattee, C.M. Bunck, and A. Anderson. 1985. Survival growth and accumulation of ingested lead in nestling American kestrels *Falco sparverius*. Arch. Environ. Contam. Toxicol. 14(1):89-94.

Hoffman, D.J., C.J. Sanderson, L.J. LeCaptain, E. Cromartie, and G.W. Pendleton. 1992. Interactive effects of arsenate, selenium, and dietary protein on survival, growth, and physiology in mallard ducklings. Arch. Environ. Contam. Toxicol. 22(1): 55-62.

Holcman, A., and V. Stibilj. 1997. Arsenic residues in eggs from laying hens fed with a diet containing arsenic (iii) oxide. Arch. Environ. Contam. Toxicol. 32(4):407-410.

Hudson, R.H., R.K. Tucker, and M.A. Haegele. 1984. Handbook of toxicity of pesticides to wildlife. U.S. Fish and Wildlife Service, Resour. Publ. 153. 90 p.

Johnson, D. Jr., A.L. Mehring, Jr., and H.W. Titus. 1960. Tolerance of chickens for barium. Proc. Soc. Exp. Biol. Med. 104:436-438.

Kezhou, W., H.D. Stowe, A.M. House, K. Chou, and T. Thiel. 1987. Comparison of cupric and sulfate ion effects on chronic selenosis in rats. J. Anim. Sci. 64(5):1467-1475.

Leach, R.M. Jr., K.W. Wang, and D.E. Baker. 1979. Cadmium and the food chain: The effect of dietary cadmium on tissue composition in chicks and laying hens. J. Nutr. 109(3):437-443.

Landis Assoc. Inc. 1985. A dietary LC50 study in the bobwhite with naphthalene (final report). EPA/OTS; Doc#86-870000551.

Nagy, K.A. 1987. Field metabolic rate and food requirement scaling in mammals and birds. Ecol. Monogr. 57:111-128.

Nagy, K.A. 2001. Food requirements of wild animals: Predictive equations for free-living mammals, reptiles, and birds. Nutr. Abstr. Rev. Series B 71:21R-31R.

Neiger, R.D., and G.D. Osweiler. 1989. Effect of subacute low level dietary sodium arsenite on dogs. Fund. Appl. Toxicol. 13:439-451.

Nemec, M.D., J.F. Holson, C.H. Farr, and R.D. Hood. 1998. Developmental toxicity assessment of arsenic acid in mice and rabbits. Reprod. Toxicol. 12(6):647-658.

Pattee, O.H. 1984. Eggshell thickness and reproduction in American kestrels exposed to chronic dietary lead. Arch. Environ. Contam. Toxicol. 13:29-34.

Rastogi, R.B., Z. Merali, and R.L. Singhal. 1977. Cadmium alters behavior and the biosynthetic capacity for catecholamines and serotonin in neo natal rat brain. J. Neurochem. 28(4):789-794.

Sample, B.E., D.M. Opresko, and G.W. Suter. 1996. Toxicological benchmarks for wildlife: 1996 Revision. Prepared by the Risk Assessment Program, Health Sciences Research Division, Oak Ridge, TN. ES/ER/TM-86/R3.

Sanchez, D., A. Ortega, J.L. Domingo, and J. Corbella. 1991. Development toxicity evaluation of orthovanadate in the mouse. Biol. Trace Elem. Res. 30(3):219-226.

Schlicker, S.A., and D.H. Cox. 1968. Maternal dietary zinc, and development and zinc, iron and copper content of the rat fetus. J. Nutr. 95:245-294.

Schroeder, H.A., and M. Mitchener. 1975. Life-term studies in rats. Effects of aluminum, barium, beryllium, and tungsten. J. Nutr. 105(4): 421-7

Schroeder, H.A., M. Mitchener, J.J. Balassa, M. Kanisawa, and A.P. Nason. 1968. Zirconium, niobium, antimony, and fluorine in mice: Effects on growth, survival and tissue levels. J. Nutr. 95:95-101.

Stanley, T.R. Jr., J.W. Spann, G.J. Smith, and R. Rosscoe. 1994. Main and interactive effects of arsenic and selenium on mallard reproduction and duckling growth and survival. Arch. Environ. Contam. Toxicol. 26(4):444-451.

Sutou, S., K. Yamamoto, H. Sendota, and M. Sugiyama. 1980. Toxicity, fertility, teratogenicity, and dominant lethal tests in rats administered cadmium subchronically. I. Fertility, teratogenicity, and dominant lethal tests. Ecotoxicol. Environ. Saf. 4(1):51-56.

Trust, K.A., A. Fairbrother, and M.J. Hooper. 1994. Effects of 7,12-dimethylbenz(a)anthracene on immune function and mixed-function oxygenase activity in the European starling. Environ. Toxicol. Chem. 13(5):821-830.

U.S. EPA. 1988. Recommendations for and documentation of biological values for use in risk assessment. EPA/600/6-87/008. U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, OH.

U.S. EPA. 1993. Wildlife exposure factors handbook. Volume I of II. EPA/600/R-93/187a. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC.

U.S. EPA. 1995. Great Lakes Water Quality Initiative technical support document for wildlife criteria. EPA-820-B-95-009. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

U.S. EPA. 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. Interim Final. EPA/630/R-92/001 U.S. Environmental Protection Agency, Environmental Response Team, Edison, NJ. February.

U.S. EPA. 1998. Guidelines for ecological risk assessment. EPA/630/R-95/002F. U.S. Environmental Protection Agency Washington, DC. April.

White, D.H., and M.P. Dieter. 1978. Effects of dietary vanadium in mallard ducks. J. Toxicol. Environ. Health. 4:43-50.

White, D.H., and M.T. Finley. 1978. Uptake and retention of dietary cadmium in mallard ducks. Environ. Res. 17(1):53-59.

Yuhas, E.M., R.C. Schnell, and T.S. Miya. 1979. Dose-related alterations in growth and mineral disposition by chronic oral cadmium administration in the male rat. Toxicol. 12(1):19-29.

Zahid, Z.R., Z.S. Al Hakkak, A.H.H. Kadhim, E.A. Elias, and I.S. Al Jumaily. 1990. Comparative effects of trivalent and hexavalent chromium on spermatogenesis of the mouse. Toxicol. Environ. Chem. 25(2-3):131-136.

Table D-1. Studies used in the toxicity reference values for mammalian wildlife

	Test Organism Information											
CoPEC	Test Species	Body Weight (kg)	Exposure Route	No-Effects Dose Concentration	Lowest Observed Effects Dose Concentration	Ingestion Rate	Endpoint	Duration of Study	Uncertainty Factor	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	References
Arsenic as Arsenate	Rabbit	4.4	oral in food	--	--	--	reproduction	18 days during gestation	--	0.75	3.0	Nemec et al. (1998)
Barium	Mouse	0.307	oral inwater	61 mg/kg/day	121 mg/kg/day	--	growth	92 days	0.1 [c]	6.1	12	Dietz et al. (1992)
Cadmium	Rat	0.303	oral gavage	1 mg/kg bw/day	10 mg/kg bw/day	--	reproduction	6 weeks through gestation	--	1.0	10	Sutou et al. (1980)
Chromium 3+	Mouse	0.0249	oral in food	--	100 ppm; 38.02% Cr3+ by MW	0.16 kg/kg/day	reproduction	35 days	0.1 [b]	0.60	5.96	Zahid et al. (1990)
Copper	Mink	1.0 [d]	oral in food	25 ppm and 60.5 ppm in food	50 ppm and 60.5 ppm in food	0.137 kg/kg bw-day[e]	kit mortality	357 days	--	12	15	Aulerich et al. (1982)
Lead	Rat	0.35 [f]	oral in food	141 ppm	1130 ppm	0.08 kg/kg/day	weight of weanlings and kidney histology	3 generations	--	11	90	Azar et al. (1973)
Mercury, methyl	Rat	0.35 [f]	oral in food	0.5 ppm	2.5 ppm	0.028 kg/day[g]	reproduction	3 generations	--	0.032	0.16	Verschuuren et al. (1976)
Nickel	Rat	0.35 [a]	oral in food	500 ppm; 22% Ni by MW	1,000 ppm; 22% Ni by MW	0.028 kg/day[g]	offspring body weight	3 generations	--	9	18	Ambrose et al. (1976)
Vanadium	Rat	0.35 [f]	oral in food	1.03 mg/kg/day	5.11 mg/kg/day	--	growth	10 weeks	0.1 [c]	0.103	0.511	Daniel and Lillie (1938)
Zinc	Sprague-Dawley rat	0.35 [a]	oral in diet	2,000 ppm	4,000 ppm	0.028 kg/day[g]	reproduction	16 days during gestation	--	160	320	Schlicker and Cox (1968)
Total PAHs	Mouse	0.038	oral in food	5 ppm	25 ppm	0.15 kg/kg/day	growth, mortality	2 years	--	0.8	3.8	Culp et al. (1998)

Note: Dose concentrations and ingestion rates are expressed in wet weight unless otherwise noted.

bw - body weight
dw - dry weight
LOAEL - lowest-observed-adverse-effect level
NOAEL - no-observed-adverse-effect level
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
TRV - toxicity reference value
UF - uncertainty factor
ww - wet weight

[a] U.S. EPA (1988).
[b] LOAEL to NOAEL UF of 0.1.
[c] Subchronic to Chronic UF of 0.1.
[d] U.S. EPA (1993)
[e] Based on the observations of Bleavins and Aulerich (1981).
[f] U.S. EPA (1995).
[g] Calculated used allometric equation from U.S. EPA (1988).
[h] TRVs for the raccoon are adjusted for differences in body weight between the test orga and the raccoon (see report text for details).

Table D-2. Mammalian toxicity reference values (TRVs) for ecological risk calculations

	Test Species				Raccoon[a]		
Chemical	Test Species	Body Weight (kg)	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	Body Weight (kg)	Final NOAEL (mg/kg/d)	Final LOAEL (mg/kg/d)
Metals							
Arsenic as Arsenate	Rabbit	4.4	0.75	3.0	6	0.69	2.80
Barium	Mouse	0.307	6.1	12	6	2.9	5.8
Cadmium	Rat	0.303	1.0	10	6	0.47	4.7
Chromium 3+	Mouse	0.0249	0.60	5.96	6	0.15	1.5
Copper	Mink	1.0	12	15	6	7.5	9.7
Lead	Rat	0.35	11	90	6	5.6	44
Mercury, methyl	Rat	0.35	0.032	0.16	6	0.016	0.08
Nickel	Rat	0.35	9	18	6	4.4	8.8
Vanadium	Rat	0.35	0.103	0.511	6	0.05	0.25
Zinc	Sprague-Dawley rat	0.35	160	320	6	79	160
Polycyclic aromatic hydrocarbons							
Total PAHs	Mouse	0.038	0.8	3.8	6	0.23	1.10

Notes:

[a] TRVs for the raccoon are adjusted for differences in body weight between the test organisms and the raccoon (see report text for details).

Table D-3. Avian toxicity reference values (TRVs) for ecological risk calculations

CoPEC	Test Species	Body Weight (kg)	Exposure Route	No-Effects Dose Concentration	Lowest Observed Effects Dose Concentration	Ingestion Rate	Endpoint	Duration of Study	Uncertainty Factor	NOAEL (mg/kg/day)	LOAEL (mg/kg/day)	References
Arsenic as Arsenate	Mallard duck	1.043 [a]	oral in food	100 ppm	400 ppm	0.1 kg/day	reproduction	4 weeks	--	10	38	Stanley et al. (1994)
Barium	Chicks	0.121 [b]	oral in food	2,000 ppm	4,000 ppm	0.0126 kg/day[a]	mortality	4 weeks	0.1 [c]	21	42	Johnson et al. (1960)
Cadmium	Mallard duck	1.153	oral in food	15.2 ppm	210 ppm	0.110 kg/day	reproduction	90 days	--	1.45	20	White and Finley (1978)
Chromium 3+	Black duck	1.25	oral in food	10 ppm	50 ppm	0.15 kg/kg/day[d]	reproduction	10 months	--	1.5	7.5	Haseltine et al. (1985) as cited in Sample et al. (1996)
Copper	Mallard duck	0.8	oral in food	218.5 ppm	420 ppm	0.26 kg/kg/day	growth	35 days	--	5.68	10.9	Foster (1999)
Lead	American kestrels	0.144	oral in food	50 ppm	--	0.01 kg/day[e]	reproduction	7 months	--	3.75	25.5	Pattee (1984); Eco-SSL (2005)
Mercury, methyl	Various	--	dietary	--	--	--	reproduction	Chronic	--	0.05	0.5	Fuchsman et al. (2017)
Nickel	Mallard ducklings	0.782	oral in food	176 ppm	774 ppm	0.17 kg/kg/day	mortality	90 days	--	31	135	Cain and Pafford (1981)
Vanadium	Mallard duck	1.17	oral in food	110 ppm	--	0.10 kg/kg/day	mortality, growth	12 weeks	--	11	n/a	White and Dieter (1978)
Zinc	Mallard duck	1.043 [a]	oral in food	--	3000 ppm	0.03 kg/kg/day	reproduction	60 days	0.1 [f]	10.2	102	Gasaway and Buss (1974)
Total PAHs	European starling	0.055	gavage	2 mg/kg/day	20 mg/kg/day	--	growth	5 days	0.1 [c]	0.2	2	Trust et al. (1994)

Note: Dose concentrations and ingestion rates are expressed in wet weight unless otherwise noted.

bw - body weight
dw - dry weight
LOAEL - lowest-observed-adverse-effect level
NOAEL - no-observed-adverse-effect level
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
TRV - toxicity reference value
UF - uncertainty factor
ww - wet weight

[a] U.S. EPA (1993).

[b] U.S. EPA (1988), mean at 5 weeks.

[c] Subchronic to Chronic UF (0.1); Acute to Chronic UF (0.01).

[d] Nagy (2001)

[e] Sample et al. (1996).

[f] LOAEL to NOAEL UF of 0.1.

Table D-4. Lead LOAEL TRV - Avian Data

Results #	Reference	Species	Route of Exposure	Exposure Duration	Duration units	Conversion	Duration days	Effect Type	Effect Measure	mg/kg/day NOAEL	mg/kg/day LOAEL	LOAEL Response Level	Specific Measure	Form	Notes
50	Edens and Garlich, 1983	Japanese quail	FD	5	w	7	35	REP	PROG	0.194	1.94	28%	Egg production	Lead acetate	Table 2 - 10 mg/kg dose represent LOAEL
51	Edens and Garlich, 1983	Chicken	FD	4	w	7	28	REP	PROG	1.63	3.26	12%	Egg production	Lead acetate	Table 1 - 4 week exposure 50 mg/kg dose represent LOAEL
52	Meluzzi et al., 1996	Chicken	FD	30	d	1	30	REP	ALWT	2.69	4.04	6%	Albumin weight	Lead Oxide	Table 5 - Albumen weight at 30 days. Weak study - no effect on albumin at 75 day, the LOAEL appears to be based on a sporative effect found at 30 days, but not at 75 day. This is a multiple metal exposure study (Cr and Ni too).
55	Morgan et al., 1975	Japanese quail	FD	5	w	7	35	REP	TEWT	12.6	126	50%	Testes weight	Lead acetate	Table 2- Testes weight at 100 ppm lead in diet represents LOAEL. Note at the next higher dose of 500 ppm the effect level was 15%. Also note 5 wk old bird response was more sensitive than 6 week old birds did not show a response.
56	Morgan et al., 1975	Japanese quail	FD	5	w	7	35	REP	TEWT	67.4	135	28%	Testes weight	Lead acetate	Table 1 - Testes weight at 1000 ppm lead in diet represents LOAEL. Note this is based on 6 wk old bird data.
64	Edens and Garlich, 1983	Japanese quail	FD	5	w	7	35	GRO	BDWT	1.56	15.6	2%	Body weight	Lead acetate	Table 4 - Japanese quail bw data. 100 mg/kg lead in diet represented LOAEL.
67	Edens and Melvin, 1989	Japanese quail	FD	4	w	7	28	GRO	BDWT	5.93	59.3	22%	Body weight	Lead acetate	Text to Figure 1 - Experiment 1 showed that Fatty had reduced growth at 6 weeks of 10 % while the random breed had a reduction of 22% based on body weight. LOAEL was represented by 500 ppm diet. Response for the random breed was reported as it appeared to be more applicable.
68	Damron et al., 1969	Chicken	FD	4	w	7	28	GRO	BDWT	6.14	61.4	39%	Body weight	Lead acetate	Table 1 - Experiment 1 body weight data; 1000 ppm dose
69	Damron et al., 1969	Chicken	FD	4	w	7	28	GRO	BDWT	7.1	71	6%	Body weight	Lead acetate	Table 1 - Experiment 2 body weight data; 1000 ppm dose

Table D-4. Lead LOAEL TRV - Avian Data

Results #	Reference	Species	Route of Exposure	Exposure Duration	Duration units	Conversion	Duration days	Effect Type	Effect Measure	mg/kg/day NOAEL	mg/kg/day LOAEL	LOAEL Response Level	Specific Measure	Form	Notes
70	Edens et. al., 1976	Japanese quail	FD	12	w	7	84	GRO	BDWT	11.1	111	21%	Body weight	Lead acetate	Table 5 - Body weight data - females only, males showed no effect at 12 weeks. LOAEL was 1000 ppm lead.
71	Edens, 1985	Japanese quail	FD	12	w	7	84	GRO	BDWT	11.2	112	18%	Body weight	Lead acetate	Table 1 - Only effect was for females at highest dose of 1000 ppm
									Data evaluation with restricted data set (5-30% response level)			18%			
									Overall Geometric Mean of restricted data set	**5**	**25.5**				

Study used by EPA to develop TRV for Eco SSL
Represents study with longest duration for Effect Type (i.e., reproduction or growth)
Represents the studies selected to develop the LOAEL, based on studies that reported a 20% or less reduction in growth or reproduction.

Criteria used to select data from that available in Eco SSL Document
1. NOAEL and LOAEL provided in study
2. Duration of exposure greater than or equal to 28 days or 4 weeks
3. Reproductive or growth effects used only

Acronyms
ALWT = albumin weight; BDWT = body weight changes; d = days; FD = food; GRO = growth; PROG = progeny counts or numbers; REP = reproduction; TEWT = testes weight; w = weeks

Appendix E

Food-chain Models for Wildlife

Table E-1. Wildlife Exposure Dose Calculations - Food-chain Model - Mallard Consuming Plants - NOAEL, Hockanum River

Model Run Information	
Species:	Mallard
Food Item:	Plants
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.16
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.0017
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.058
Fraction of Diet as Invertebrate (FDin) (-)	1
Site Utilization Factor (SUF) (-)	1

	CoPEC Concentration (mg/kg dw)	Sediment Concentration (mg/kg ww)	Plants Concentration (mg/L)	Surface Water Concentration (mg/kg/day)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	7.30E+00	5.48E-02	4.00E-03	8.59E-03	1.21E-02	2.33E-04	2.09E-02	9.59E+00	reproduction	9.0E-04	1.3E-03	2.4E-05	2E-03
Barium	3.24E+02	1.01E+01	5.60E-02	1.58E+00	5.36E-01	3.26E-03	2.12E+00	2.08E+01	mortality	7.6E-02	2.6E-02	1.6E-04	1E-01
Cadmium	2.90E+00	2.22E-01	1.00E-03	3.49E-02	4.80E-03	5.82E-05	3.97E-02	1.45E+00	reproduction	2.4E-02	3.3E-03	4.0E-05	3E-02
Chromium	6.64E+01	5.44E-01	1.00E-03	8.53E-02	1.10E-01	5.82E-05	1.95E-01	1.50E+00	reproduction	5.7E-02	7.3E-02	3.9E-05	1E-01
Copper	2.19E+03	8.08E+00	5.00E-03	1.27E+00	3.62E+00	2.91E-04	4.89E+00	5.68E+00	growth	2.2E-01	6.4E-01	5.1E-05	9E-01
Lead	2.67E+02	1.22E+00	2.00E-03	1.91E-01	4.42E-01	1.16E-04	6.33E-01	3.75E+00	reproduction	5.1E-02	1.2E-01	3.1E-05	2E-01
Mercury	2.10E-01	3.16E-02	2.00E-04	4.95E-03	3.48E-04	1.16E-05	5.31E-03	5.00E-02	reproduction	9.9E-02	7.0E-03	2.3E-04	1E-01
Nickel	4.16E+01	3.52E-01	1.00E-03	5.52E-02	6.88E-02	5.82E-05	1.24E-01	3.10E+01	mortality	1.8E-03	2.2E-03	1.9E-06	4E-03
Vanadium	1.09E+02	1.06E-01	2.00E-03	1.66E-02	1.80E-01	1.16E-04	1.97E-01	1.10E+01	mortality, growth	1.5E-03	1.6E-02	1.1E-05	2E-02
Zinc	6.06E+02	3.36E+01	6.00E-03	5.27E+00	1.00E+00	3.49E-04	6.27E+00	1.02E+01	reproduction	5.2E-01	9.8E-02	3.4E-05	6E-01
Total PAHs	1.00E+02	1.04E+01	2.00E-03	1.63E+00	1.66E-01	1.16E-04	1.80E+00	2.00E-01	growth	8.2E+00	8.3E-01	5.8E-04	9E+00

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons

Table E-2. Wildlife Exposure Dose Calculations - Food-chain Model - Great Blue Heron Consuming Fish and Benthic Invertebrates - NOAEL, Hockanum River

Model Run Information	
Species:	Great Blue Heron Fish and Benthic
Food Item:	Invertebrates
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.12
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.00053
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.045
Fraction of Diet as Invertebrate (FDin) (-)	1
Site Utilization Factor (SUF) (-)	1

CoPEC	Benthic Sediment Concentration (mg/kg dw)	Fish Concentration (mg/kg ww)	Invertebrates Concentration (mg/kg ww)	Surface Water Concentration (mg/L)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	7.30E+00	1.51E+00	6.86E-01	4.00E-03	1.30E-01	3.88E-03	1.82E-04	1.34E-01	9.59E+00	reproduction	1.4E-02	4.0E-04	1.9E-05	1E-02
Barium	3.24E+02	8.85E+00	8.85E+00	5.60E-02	1.05E+00	1.72E-01	2.55E-03	1.22E+00	2.08E+01	mortality	5.0E-02	8.3E-03	1.2E-04	6E-02
Cadmium	2.90E+00	3.43E+00	6.86E-01	1.00E-03	2.44E-01	1.54E-03	4.55E-05	2.46E-01	1.45E+00	reproduction	1.7E-01	1.1E-03	3.1E-05	2E-01
Chromium	6.64E+01	2.25E-01	2.25E+00	1.00E-03	1.47E-01	3.53E-02	4.55E-05	1.82E-01	1.50E+00	reproduction	9.8E-02	2.4E-02	3.0E-05	1E-01
Copper	2.19E+03	1.56E+01	3.12E+01	5.00E-03	2.78E+00	1.16E+00	2.27E-04	3.94E+00	5.68E+00	growth	4.9E-01	2.0E-01	4.0E-05	7E-01
Lead	2.67E+02	1.32E+00	4.41E+00	2.00E-03	3.40E-01	1.42E-01	9.10E-05	4.82E-01	3.75E+00	reproduction	9.1E-02	3.8E-02	2.4E-05	1E-01
Mercury	2.10E-01	3.08E-01	3.85E-02	2.00E-04	2.06E-02	1.12E-04	9.10E-06	2.07E-02	5.00E-02	reproduction	4.1E-01	2.2E-03	1.8E-04	4E-01
Nickel	4.16E+01	2.79E+00	1.86E+00	1.00E-03	2.76E-01	2.21E-02	4.55E-05	2.98E-01	3.10E+01	mortality	8.9E-03	7.1E-04	1.5E-06	1E-02
Vanadium	1.09E+02	5.49E-01	1.37E+00	2.00E-03	1.14E-01	5.79E-02	9.10E-05	1.72E-01	1.10E+01	mortality, growth	1.0E-02	5.3E-03	8.3E-06	2E-02
Zinc	6.06E+02	7.18E+01	7.18E+01	6.00E-03	8.51E+00	3.22E-01	2.73E-04	8.84E+00	1.02E+01	reproduction	8.3E-01	3.2E-02	2.7E-05	9E-01
Total PAHs	1.00E+02	1.51E+01	3.01E+01	2.00E-03	2.68E+00	5.34E-02	9.10E-05	2.73E+00	2.00E-01	growth	1.3E+01	2.7E-01	4.5E-04	1E+01

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons

Table E-3. Wildlife Exposure Dose Calculations - Food-chain Model - Raccoon Consuming Fish and Benthic Invertebrates - NOAEL, Hockanum River

Model Run Information	
Species:	Raccoon
	Fish and Benthic
Food Item:	Invertebrates
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.082
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.0025
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.083
Site Utilization Factor (SUF) (-)	1

CoPEC	Sediment Concentration (mg/kg dw)	Fish Concentration (mg/kg ww)	Benthic Invertebrates Concentration (mg/kg ww)	Surface Water Concentration (mg/L)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	7.30E+00	1.51E+00	6.86E-01	4.00E-03	8.97E-02	1.80E-02	3.31E-04	1.08E-01	6.90E-01	reproduction	1.3E-01	2.6E-02	4.8E-04	2E-01
Barium	3.24E+02	8.85E+00	8.85E+00	5.60E-02	7.23E-01	7.99E-01	4.63E-03	1.53E+00	2.90E+00	growth	2.5E-01	2.8E-01	1.6E-03	5E-01
Cadmium	2.90E+00	3.43E+00	6.86E-01	1.00E-03	1.68E-01	7.15E-03	8.28E-05	1.76E-01	4.70E-01	reproduction	3.6E-01	1.5E-02	1.8E-04	4E-01
Chromium	6.64E+01	2.25E-01	2.25E+00	1.00E-03	1.01E-01	1.64E-01	8.28E-05	2.65E-01	1.50E-01	reproduction	6.7E-01	1.1E+00	5.5E-04	2E+00
Copper	2.19E+03	1.56E+01	3.12E+01	5.00E-03	1.92E+00	5.40E+00	4.14E-04	7.32E+00	7.50E+00	kit mortality	2.6E-01	7.2E-01	5.5E-05	9.8E-01
Lead	2.67E+02	1.32E+00	4.41E+00	2.00E-03	2.35E-01	6.59E-01	1.66E-04	8.93E-01	5.60E+00	weight of weanlings and kidney histology	4.2E-02	1.2E-01	3.0E-05	2E-01
Mercury	2.10E-01	3.08E-01	3.85E-02	2.00E-04	1.42E-02	5.18E-04	1.66E-05	1.47E-02	1.60E-02	reproduction	8.9E-01	3.2E-02	1.0E-03	9E-01
Nickel	4.16E+01	2.79E+00	1.86E+00	1.00E-03	1.90E-01	1.03E-01	8.28E-05	2.93E-01	4.40E+00	offspring body weight	4.3E-02	2.3E-02	1.9E-05	7E-02
Vanadium	1.09E+02	5.49E-01	1.37E+00	2.00E-03	7.86E-02	2.69E-01	1.66E-04	3.48E-01	5.10E-02	growth	1.5E+00	5.3E+00	3.2E-03	7E+00
Zinc	6.06E+02	7.18E+01	7.18E+01	6.00E-03	5.87E+00	1.49E+00	4.97E-04	7.36E+00	7.90E+01	reproduction	7.4E-02	1.9E-02	6.3E-06	9E-02
Total PAHs	1.00E+02	1.51E+01	3.01E+01	2.00E-03	1.85E+00	2.48E-01	1.66E-04	2.09E+00	2.30E-01	growth, mortality	8.0E+00	1.1E+00	7.2E-04	9E+00

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons

Appendix F

Supporting Tables for Evaluation of Sediment and Surface Water Data Upstream of the Rockville Former MGP Site, Rockville, Vernon, Connecticut

Table F-1. Benthic invertebrate assessment endpoint results - hazard quotients using sediment toxicity reference values - upstream data

CoPEC	Units	MDC/MRL	Sediment Screening Level	HQ	Comment
Arsenic	mg/kg	1.4	9.79	0.1	Results do not indicate a potential risk
Barium	mg/kg	26	0.7	37	Results indicate a potential risk
Cadmium	mg/kg	1.2	0.99	1	Results indicate a potential risk
Chromium (Total)	mg/kg	18	43.4	0.4	Results do not indicate a potential risk
Copper	mg/kg	24	31.6	0.8	Results do not indicate a potential risk
Lead	mg/kg	57	35.8	2	Results indicate a potential risk
Mercury	mg/kg	0.02	0.18	0.11	Results do not indicate a potential risk
Nickel	mg/kg	7.6	22.7	0.3	Results do not indicate a potential risk
Vanadium	mg/kg	35	50	0.7	Results do not indicate a potential risk
Zinc	mg/kg	150	121	1	Results indicate a potential risk
Methylnaphthalene, 2-	mg/kg	0.091	0.0202	5	Results indicate a potential risk
Acenaphthene	mg/kg	0.15	0.0067	22	Results indicate a potential risk
Acenaphthylene	mg/kg	0.89	0.0059	151	Results indicate a potential risk
Anthracene	mg/kg	0.79	0.0572	14	Results indicate a potential risk
Benzo(a)anthracene	mg/kg	2.3	0.108	21	Results indicate a potential risk
Benzo(a)pyrene	mg/kg	2.1	0.15	14	Results indicate a potential risk
Benzo(b)fluoranthene	mg/kg	2.5	10.4	0.2	Results do not indicate a potential risk
Benzo(g,h,i)perylene	mg/kg	1.7	0.17	10	Results indicate a potential risk
Benzo(k)fluoranthene	mg/kg	0.81	0.0272	30	Results indicate a potential risk
Chrysene	mg/kg	2.3	0.166	14	Results indicate a potential risk
Dibenz(a,h)anthracene	mg/kg	0.51	0.033	15	Results indicate a potential risk
Fluoranthene	mg/kg	5.1	0.423	12	Results indicate a potential risk
Fluorene	mg/kg	0.34	0.0774	4	Results indicate a potential risk
Indeno(1,2,3-cd)pyrene	mg/kg	1.5	0.0173	87	Results indicate a potential risk
Naphthalene	mg/kg	0.43	0.176	2	Results indicate a potential risk
Phenanthrene	mg/kg	3.3	0.204	16	Results indicate a potential risk
Pyrene	mg/kg	4.7	0.195	24	Results indicate a potential risk
Total PAHs	mg/kg	28	1.61	18	Results indicate a potential risk

Notes:
MDC - maximum detected concentration
MRL - maximum reporting limit
HQ>1 are highlighted in yellow, indicating a potential risk.
PAHs - polycyclic aromatic hydrocarbons

Table F-2. Amphibian and fish assessment endpoints results - hazard quotients for aquatic life using surface water toxicity reference values - upstream data

CoPEC	Units	MDC/MRL	Fish Surface Water SL	Fish Surface Water SL HQ	Amphibian Value	Amphibian Value HQ	Comment
Arsenic	mg/L	0.002	0.15	0.01	0.04	0.05	Results do not indicate a potential risk
Barium	mg/L	0.058	0.0039	15	244	0.0002	Results indicate a potential risk
Cadmium	mg/L	0.002	0.000125	16	0.019	0.11	Results indicate a potential risk
Chromium (Total)	mg/L	0.004	0.011	0.36	0.03	0.13	Results do not indicate a potential risk
Copper	mg/L	0.004	0.0048	0.8	0.015	0.3	Results do not indicate a potential risk
Lead	mg/L	0.0012	0.0012	1.0	0.04	0.03	Results do not indicate a potential risk
Mercury	mg/L	0.0002	0.00077	0.3	0.001	0.2	Results do not indicate a potential risk
Nickel	mg/L	0.004	0.0289	0.14	0.05	0.08	Results do not indicate a potential risk
Vanadium	mg/L	0.004	0.019	0.2	0.25	0.016	Results do not indicate a potential risk
Zinc	mg/L	0.016	0.065	0.25	0.01	2	Results indicate a potential risk
Methylnaphthalene, 2-	mg/L	0.00005	0.0047	0.0	NR	NA	Results do not indicate a potential risk
Acenaphthene	mg/L	0.00005	0.023	0.002	NR	NA	Results do not indicate a potential risk
Acenaphthylene	mg/L	0.00005	4.84	0.00001	NR	NA	Results do not indicate a potential risk
Anthracene	mg/L	0.00005	0.00073	0.07	0.025	0.002	Results do not indicate a potential risk
Benzo(a)anthracene	mg/L	0.00005	0.000027	2	NR	NA	Results indicate a potential risk
Benzo(a)pyrene	mg/L	0.00005	0.000014	4	3.33	2E-05	Results indicate a potential risk
Benzo(b)fluoranthene	mg/L	0.00005	0.00907	0.006	NR	NA	Results do not indicate a potential risk
Benzo(g,h,i)perylene	mg/L	0.00005	0.00764	0.01	NR	NA	Results do not indicate a potential risk
Benzo(k)fluoranthene	mg/L	0.00005	NR	NA	NR	NA	No values to compute HQs
Chrysene	mg/L	0.00005	NR	NA	NR	NA	No values to compute HQs
Dibenz(a,h)anthracene	mg/L	0.00005	NR	NA	NR	NA	No values to compute HQs
Fluoranthene	mg/L	0.00005	0.0081	0.006	0.052	0.001	Results do not indicate a potential risk
Fluorene	mg/L	0.00005	0.0039	0.01	NR	NA	Results do not indicate a potential risk
Indeno(1,2,3-cd)pyrene	mg/L	0.00005	0.00431	0.01	NR	NA	Results do not indicate a potential risk
Naphthalene	mg/L	0.0002	0.024	0.008	2.1	1E-04	Results do not indicate a potential risk
Phenanthrene	mg/L	0.00005	0.0063	0.008	NR	NA	Results do not indicate a potential risk
Pyrene	mg/L	0.00005	0.000025	2	0.14	0.0004	Results indicate a potential risk
Total PAHs	mg/L	0.002	NR	NA	NR	NA	No values to compute HQs

Notes:
MDC - maximum detected concentration
MRL - maximum reporting limit
NR - not reported
NA - not applicable
HQ>1 are highlighted in yellow, indicating a potential risk.

Table F-3. Wildlife assessment endpoint results - hazard quotients for the mallard, great blue heron, and raccoon - upstream data

	Mallard (aquatic plant consumer)		Great Blue Heron (fish and invertebrate consumer)		Raccoon (fish and invertebrate consumer)	
CoPEC	Total Chemical Intake (mg/kg/day)	HQ (unitless)	Total Chemical Intake (mg/kg/day)	HQ (unitless)	Total Chemical Intake (mg/kg/day)	HQ (unitless)
Arsenic	4.08E-03	0.0004	3.83E-02	0.004	2.94E-02	0.04
Barium	1.74E-01	0.008	1.01E-01	0.005	1.27E-01	0.04
Cadmium	2.36E-02	0.02	1.33E-01	0.09	9.45E-02	0.2
Chromium (Total)	5.32E-02	0.04	1.01E-01	0.07	1.07E-01	0.7
Copper	2.54E-01	0.04	8.06E-01	0.1	6.06E-01	0.08
Lead	1.75E-01	0.05	1.29E-01	0.03	2.09E-01	0.04
Mercury	1.42E-03	0.03	9.55E-03	0.2	6.63E-03	0.4
Nickel	2.83E-02	0.0009	5.72E-01	0.02	4.10E-01	0.09
Vanadium	6.35E-02	0.006	5.54E-02	0.01	1.12E-01	2
Zinc	2.68E+00	0.3	6.45E+00	0.6	4.76E+00	0.06
Total PAHs	5.80E-01	3	7.70E-01	4	5.90E-01	3

Notes:

PAHs - polycyclic aromatic hydrocarbons

PAHs were evaluated as the sum of individual PAHs or total PAHs.

HQ>1 are highlighted in yellow, indicating a potential risk.

Table F-4. Wildlife Exposure Dose Calculations - Food-chain Model - Mallard Consuming Plants - NOAEL, Hockanum River - Upstream Data

Model Run Information	
Species:	Mallard
Food Item:	Plants
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.16
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.0017
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.058
Fraction of Diet as Invertebrate (FDin) (-)	1
Site Utilization Factor (SUF) (-)	1

	CoPEC Concentration (mg/kg dw)	Sediment Concentration (mg/kg ww)	Plants Concentration (mg/L)	Surface Water Concentration (mg/L)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	1.40E+00	1.05E-02	2.00E-03		1.65E-03	2.32E-03	1.16E-04	4.08E-03	9.59E+00	reproduction	1.7E-04	2.4E-04	1.2E-05	4E-04
Barium	2.60E+01	8.11E-01	5.80E-02		1.27E-01	4.30E-02	3.37E-03	1.74E-01	2.08E+01	mortality	6.1E-03	2.1E-03	1.6E-04	8E-03
Cadmium	1.20E+00	1.37E-01	2.00E-03		2.15E-02	1.99E-03	1.16E-04	2.36E-02	1.45E+00	reproduction	1.5E-02	1.4E-03	8.0E-05	2E-02
Chromium	1.80E+01	1.48E-01	4.00E-03		2.31E-02	2.98E-02	2.33E-04	5.32E-02	1.50E+00	reproduction	1.5E-02	2.0E-02	1.6E-04	4E-02
Copper	2.40E+01	1.36E+00	4.00E-03		2.14E-01	3.97E-02	2.33E-04	2.54E-01	5.68E+00	growth	3.8E-02	7.0E-03	4.1E-05	4E-02
Lead	5.70E+01	5.12E-01	1.20E-03		8.03E-02	9.43E-02	6.98E-05	1.75E-01	3.75E+00	reproduction	2.1E-02	2.5E-02	1.9E-05	5E-02
Mercury	2.00E-02	8.79E-03	2.00E-04		1.38E-03	3.31E-05	1.16E-05	1.42E-03	5.00E-02	reproduction	2.8E-02	6.6E-04	2.3E-04	3E-02
Nickel	7.60E+00	9.87E-02	4.00E-03		1.55E-02	1.26E-02	2.33E-04	2.83E-02	3.10E+01	mortality	5.0E-04	4.1E-04	7.5E-06	9E-04
Vanadium	3.50E+01	3.40E-02	4.00E-03		5.32E-03	5.79E-02	2.33E-04	6.35E-02	1.10E+01	mortality, growth	4.8E-04	5.3E-03	2.1E-05	6E-03
Zinc	1.50E+02	1.55E+01	1.60E-02		2.43E+00	2.48E-01	9.31E-04	2.68E+00	1.02E+01	reproduction	2.4E-01	2.4E-02	9.1E-05	3E-01
Total PAHs	2.83E+01	3.40E+00	2.00E-03		5.33E-01	4.68E-02	1.16E-04	5.80E-01	2.00E-01	growth	2.7E+00	2.3E-01	5.8E-04	3E+00

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons

Table F-5. Wildlife Exposure Dose Calculations - Food-chain Model - Great Blue Heron Consuming Fish and Benthic Invertebrates - NOAEL, Hockanum River - Upstream Data

Model Run Information	
Species:	Great Blue Heron
	Fish and Benthic
Food Item:	Invertebrates
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.12
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.00053
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.045
Fraction of Diet as Invertebrate (FDin) (-)	1
Site Utilization Factor (SUF) (-)	1

CoPEC	Benthic Sediment Concentration (mg/kg dw)	Fish Concentration (mg/kg ww)	Invertebrates Concentration (mg/kg ww)	Surface Water Concentration (mg/L)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	1.40E+00	4.34E-01	1.97E-01	2.00E-03	3.75E-02	7.44E-04	9.10E-05	3.83E-02	9.59E+00	reproduction	3.9E-03	7.8E-05	9.5E-06	4E-03
Barium	2.60E+01	7.10E-01	7.10E-01	5.80E-02	8.42E-02	1.38E-02	2.64E-03	1.01E-01	2.08E+01	mortality	4.0E-03	6.6E-04	1.3E-04	5E-03
Cadmium	1.20E+00	1.86E+00	3.73E-01	2.00E-03	1.33E-01	6.38E-04	9.10E-05	1.33E-01	1.45E+00	reproduction	9.1E-02	4.4E-04	6.3E-05	9E-02
Chromium	1.80E+01	1.39E-01	1.39E+00	4.00E-03	9.10E-02	9.57E-03	1.82E-04	1.01E-01	1.50E+00	reproduction	6.1E-02	6.4E-03	1.2E-04	7E-02
Copper	2.40E+01	4.45E+00	8.91E+00	4.00E-03	7.93E-01	1.28E-02	1.82E-04	8.06E-01	5.68E+00	growth	1.4E-01	2.2E-03	3.2E-05	1E-01
Lead	5.70E+01	3.84E-01	1.28E+00	1.20E-03	9.88E-02	3.03E-02	5.46E-05	1.29E-01	3.75E+00	reproduction	2.6E-02	8.1E-03	1.5E-05	3E-02
Mercury	2.00E-02	1.43E-01	1.78E-02	2.00E-04	9.53E-03	1.06E-05	9.10E-06	9.55E-03	5.00E-02	reproduction	1.9E-01	2.1E-04	1.8E-04	2E-01
Nickel	7.60E+00	5.74E+00	3.83E+00	4.00E-03	5.67E-01	4.04E-03	1.82E-04	5.72E-01	3.10E+01	mortality	1.8E-02	1.3E-04	5.9E-06	2E-02
Vanadium	3.50E+01	1.76E-01	4.41E-01	4.00E-03	3.66E-02	1.86E-02	1.82E-04	5.54E-02	1.10E+01	mortality, growth	3.3E-03	1.7E-03	1.7E-05	5E-03
Zinc	1.50E+02	5.37E+01	5.37E+01	1.60E-02	6.37E+00	7.97E-02	7.28E-04	6.45E+00	1.02E+01	reproduction	6.2E-01	7.8E-03	7.1E-05	6E-01
Total PAHs	2.83E+01	4.24E+00	8.48E+00	2.00E-03	7.55E-01	1.50E-02	9.10E-05	7.70E-01	2.00E-01	growth	3.8E+00	7.5E-02	4.5E-04	4E+00

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons

Table F-6. Wildlife Exposure Dose Calculations - Food-chain Model - Raccoon Consuming Fish and Benthic Invertebrates - NOAEL, Hockanum River - Upstream Data

Model Run Information	
Species:	Raccoon
	Fish and Benthic
Food Item:	Invertebrates
TRV Type:	NOAEL

Parameter:	Value
Normalized Food Ingestion Rate (NFIR) (kg ww/kg-day)	0.082
Normalized Sediment Ingestion Rate (NSIR) (kg dw/kg-day)	0.0025
Normalized Water Ingestion Rate (NWIR) (L/kg-day)	0.083
Site Utilization Factor (SUF) (-)	1

CoPEC	Sediment Concentration (mg/kg dw)	Fish Concentration (mg/kg ww)	Benthic Invertebrates Concentration (mg/kg ww)	Surface Water Concentration (mg/L)	Chemical Intake Due to Food Ingestion (mg/kg/day)	Chemical Intake Due to Sediment Ingestion (mg/kg/day)	Chemical Intake Due to Water Ingestion (mg/kg/day)	Total Chemical Intake (mg/kg/day)	Toxicity Reference Value (mg/kg/day)	Toxicity Reference Value Endpoint	Hazard Quotient Due to Food Ingestion (-)	Hazard Quotient Due to Sediment Ingestion (-)	Hazard Quotient Due to Water Ingestion (-)	Total Hazard Quotient (-)
Arsenic	1.40E+00	4.34E-01	1.97E-01	2.00E-03	2.58E-02	3.45E-03	1.66E-04	2.94E-02	6.90E-01	reproduction	3.7E-02	5.0E-03	2.4E-04	4E-02
Barium	2.60E+01	7.10E-01	7.10E-01	5.80E-02	5.80E-02	6.41E-02	4.80E-03	1.27E-01	2.90E+00	growth	2.0E-02	2.2E-02	1.7E-03	4E-02
Cadmium	1.20E+00	1.86E+00	3.73E-01	2.00E-03	9.14E-02	2.96E-03	1.66E-04	9.45E-02	4.70E-01	reproduction	1.9E-01	6.3E-03	3.5E-04	2E-01
Chromium	1.80E+01	1.39E-01	1.39E+00	4.00E-03	6.27E-02	4.44E-02	3.31E-04	1.07E-01	1.50E-01	reproduction	4.2E-01	3.0E-01	2.2E-03	7E-01
Copper	2.40E+01	4.45E+00	8.91E+00	4.00E-03	5.46E-01	5.92E-02	3.31E-04	6.06E-01	7.50E+00	kit mortality	7.3E-02	7.9E-03	4.4E-05	8.1E-02
Lead	5.70E+01	3.84E-01	1.28E+00	1.20E-03	6.81E-02	1.41E-01	9.93E-05	2.09E-01	5.60E+00	weight of weanlings and kidney histology	1.2E-02	2.5E-02	1.8E-05	4E-02
Mercury	2.00E-02	1.43E-01	1.78E-02	2.00E-04	6.57E-03	4.93E-05	1.66E-05	6.63E-03	1.60E-02	reproduction	4.1E-01	3.1E-03	1.0E-03	4E-01
Nickel	7.60E+00	5.74E+00	3.83E+00	4.00E-03	3.91E-01	1.87E-02	3.31E-04	4.10E-01	4.40E+00	offspring body weight	8.9E-02	4.3E-03	7.5E-05	9E-02
Vanadium	3.50E+01	1.76E-01	4.41E-01	4.00E-03	2.52E-02	8.63E-02	3.31E-04	1.12E-01	5.10E-02	growth	4.9E-01	1.7E+00	6.5E-03	2E+00
Zinc	1.50E+02	5.37E+01	5.37E+01	1.60E-02	4.39E+00	3.70E-01	1.32E-03	4.76E+00	7.90E+01	reproduction	5.6E-02	4.7E-03	1.7E-05	6E-02
Total PAHs	2.83E+01	4.24E+00	8.48E+00	2.00E-03	5.20E-01	6.98E-02	1.66E-04	5.90E-01	2.30E-01	growth, mortality	2.3E+00	3.0E-01	7.2E-04	3E+00

Notes:
dw - dry weight
ww - wet weight
PAHs - polycyclic aromatic hydrocarbons